WAVETEK

MAINTENANCE MANUAL

Model 295

Synthesized 50 MHz Multichannel Arbitrary Waveform Generator

For Model 295 Operation Information, refer to separate Operator's Manual, P/N 1006-00-0675-01.

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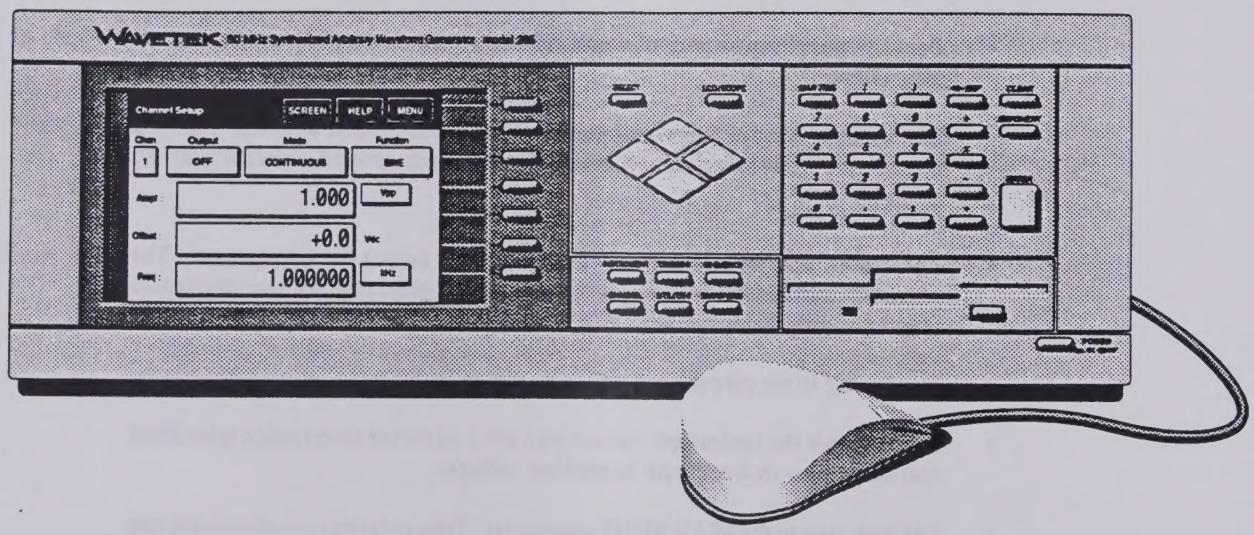


Model 295 Synthesized 50 MHz Multichannel Arbitrary Waveform Generator

1.1 INTRODUCTION

This manual contains information on the testing, calibrating, and servicing of the Wavetek Model 295 50 MHz Arbitrary Waveform Generator (Arb).

1.1.1 How to Use This Manual

The purpose of the maintenance manual is to support the technician in keeping the Model 295 functioning correctly. The material in this manual is organized in such a way as to aid the service technician in identifying and isolating a problem with the unit.

1.1.2 What is in This Manual

This manual contains the following sections:

Section 1	How to Use This Manual.
Section 2	Instrument Specifications.
Section 3	Routine Preventive Maintenance.
Section 4	Calibration (Verification and Alignment).
Section 5	Parts Lists, Assembly Drawings, and Schematics.
Appendix A	Information and Error Messages
Appendix B	Menus – Quick Reference
Appendix C	SCPI Command - Quick Reference
Appendix D	High Voltage Module
Appendix E	Rack Ears and Slides Information
Appendix F	Recommended Spare Parts

1.1.3 Routine Instrument Operation

This manual does not cover the routine operation of the Model 295. The Model 295 Operator's Manual (p/n 1006-00-0675-01) contains that information.

1.1.4 Suspected Malfunctions

If the Model 295 does not operate correctly, check the instrument setup before trying to isolate the problem; refer to the Model 295 Operator's Manual. Or, perform an AutoCal on the unit to see if the instrument will correct the problem itself; refer to section 4 of this manual. If there is a problem, performing AutoCal causes the unit to return an error message.

If the problem is known, turn to the appropriate section and correct the fault. Use the Alignment procedure in section 4, when the Model 295 appears out of calibration. Also, the Model 295 provides error messages (Appendix A) which can guide the technician. The schematics, and assembly drawings all support problem isolation.

1.1.5 Spare and Replacement Parts

Users who plan to service the Model 295 may choose to order spare parts from Wavetek. Each assembly contains a parts list; refer to section 5, Parts Lists, Assembly Drawings, and Schematics. All parts listed may be ordered directly from Wavetek. In addition, a recommended spare parts package (Wavetek part number 1200-00-4380) can be ordered from Wavetek (refer to Appendix F).

2.1 MODEL 295

Model 295 is a high-performance Synthesized Arbitrary Waveform Generator (arb) with the following main features:

- Up to 4 Independent Channels
- Up to 50 MHz Sampling Frequency with ±2 ppm Accuracy
- 12 Bit Vertical Resolution with up to 15 Vp-p Output
- A Graphical Interface Simplifies Instrument Setup
- 32k points (128k optional) Horizontal Resolution
- Waveform Linking, Looping and Sequencing
- Intermodule Triggering, Summing and Phase Control
- 100 Vp-p Optional High Voltage Outputs
- Optional Floppy Disk Drive for DSO Waveform Upload and Waveform Data Transfer and Storage
- IEEE-488.2 (SCPI) Compatible Command Language

The Model 295 allows you to generate both standard and user defined (arbitrary) waveforms. It has a repertoire of standard waveforms, a drawing capability, an equation parser, and a versatile editor. With the editor, you can modify and/or combine existing waveforms. Waveforms can also be looped to provide repetitious or continuous output, and they can be linked to form sequences.

Featured are flat panel graphics display with "pop-up" windows and waveform editing augmented with a mouse. The instrument uses an internal 50 MHz clock reference frequency to provide standard, built-in waveform outputs. The frequency range for all standard waveforms is 1 μHz to at least 2 MHz; the upper range of sine and square extends to 20 MHz and 25 MHz respectively. A TTL clock signal usable to 100 MHz is available on the Clock Out BNC. An optional 3.5 inch disk drive enhances waveform storage.

Arbitrary waveforms use a synthesized sample clock ranging from 125 mHz to 50 MHz, with 5 digits of resolution. The waveform resolution is 5 points to 32k points (optionally 128k points) horizontally and 12 bits vertically.

The basic instrument includes a mouse and contains a single arb Channel module. Waveform storage of the single channel unit is in battery-backed RAM on the internal processor assembly. Up to three additional arb channel modules can be added along with the optional disk drive. For adequate waveform storage in multichannel systems, the disk drive is recommended. The disk drive provides additional advantages, such as enabling the loading of waveforms generated on a PC using Wavetek's WaveForm DSP™ software or spreadsheet applications.

The main waveform output provides up to 15 Vp-p into 50Ω (30 Vp-p, open circuit). Waveform dc offset or dc output is also provided up to ±7.5V into 50Ω (±15V into open circuit). A signal programmed at a channel output may be sent to the backplane summing bus, or a signal present at the summing bus may be summed into a channel output. In parallel operation, Model 295 channels can be slaved to a master clock/trigger bus on the chassis backplane to create a multichannel waveform synthesizer with phase control between channels.

A High Voltage Option channel card provides channel summing with outputs up to 100 Vp-p.

The control language adheres to the SCPI (Standard Commands for Programmable Instruments) format Version 1992.0, February 1992 (refer to the SCPI manual for further information). SCPI is an industry standard language for remote instrument programming.

The Model 295 has extensive self-adjustment utilities built in. Calibration constants are maintained in nonvolatile memory.

2.2 SPECIFICATIONS

Performance specifications apply within the specified environmental conditions after a 20 minute warm up period. Specifications are subject to change without notice.

2.2.1 Standard Waveforms (Functions)

Model 295 generates arbitrary (user-defined) waveforms. In addition, 10 standard functions are included.

Sinusoid	Square	Triangle
Pseudo-Random (noise)	Positive Ramp	Negative Ramp
Pos Haversine	Neg Haversine	Sinc (Sin(x)/x)
DC		

NOTE *Model 295 includes an "internal" waveform (Wtst) reserved for diagnostics. Attempting to use the Wtst waveform or to use "Wtst" in the name for an arbitrary waveform will generate an error message.*

2.2.2 User-Defined (Arbitrary) Waveform Creation and Editing

The user can create arbitrary waveforms of any size limited only by the available channel memory. User-defined waveforms may be created via front panel editing controls (keyboard and mouse), or downloaded through GPIB interface, optional floppy disk, or optional direct DSO download.

Front panel waveform creation and editing is accomplished using the mouse and/or front panel keys assisted by Z-Axis modulation of an external oscilloscope.

Resolution

Horizontal Resolution:	32k points, 128k points optional (minimum waveform size 5 points).
Vertical Resolution:	12 bits

Arb Clock (Sample Frequency)

Range:	125.1 mHz to 50 MHz.
Resolution:	5 digits or 0.1 mHz.
Accuracy:	<±2 ppm over 0°C to +50°C using internal reference.

Waveform Editing

An oscilloscope can be connected to the Model 295 to create or edit waveforms. The mouse, in combination with Z-axis modulation, creates a "drawing" environment on the oscilloscope's screen. Horizontal and vertical scaling minimize the user's need to adjust the oscilloscope while editing.

Drawing Tools

Model 295 provides the following tools for waveform editing. Some tools require selection of a "block" (from 5 waveform data points up to the size of the waveform) before using the tool.

Copy

Copies the selected block into the clipboard.

Delete

Deletes the selected block. The data value for each point in the block becomes zero.

Freehand Draw

Sketches waveforms directly on the oscilloscope. Does not require a block to be selected.

Line Draw

Draws lines between end points, selected using the mouse. Does not require a block to be selected.

Math

Replaces the block with a math expression. With the exceptions of Line and Block, Model 295 normalizes the full-block "amplitude" between plus and minus one. The following expressions are supported:

Line(y1, y2)	Replaces the block with a line beginning at "y1" and ending at "y2".
Sine(t x n+p)	Replaces the block with "n" cycles of a Sine wave shifted by "p", a fraction of the cycle.
Triangle(n, d)	Replaces the block with "n" cycles of a Triangle wave with duty cycle "d" as a percentage.
Pulse(n, d)	Replaces the block with "n" cycles of a Pulse with duty cycle "d" as a percentage.

Tangent(t x n+p)	Replaces the block with "n" cycles of a Tangent wave shifted by "p", a fraction of the cycle. The Tangent is limited to plus or minus 1 between 87 and 93 degrees and between 267 and 273 degrees.
Exponential(t x n+p)	Replaces the block with "n" cycles of an Exponential wave shifted by "p", a fraction of the cycle. A cycle begins with Exp(0) and ends at Exp(3) [1 to 20.09]. The cycle is offset and scaled to lie between plus and minus one.
Log(t x n+p)	Replaces the block with "n" cycles of a Log base 10 wave shifted by "p", a fraction of the cycle. A cycle begins with Log(0.1) and ends at Log(10) [-1 to +1].
Random	Replaces the block with a random function scaled between plus and minus one. Requires no arguments.
Block	The selected block becomes part of the math expression. Useful for scaling or adding another function into the selected block.

Insert

Inserts a copied block from the clipboard into a waveform. The operation does not erase the clipboard, and additional pasting can be done as needed. Only a start point needs to be selected for insertion.

VertMov

Vertically offsets a block. Peak amplitude of the block cannot exceed plus or minus one.

VertRsz

Changes peak-to-peak amplitude including inverting amplitude.

Zoom

Magnifies a block to fill the entire oscilloscope screen. Zoom can be repeated as many times as needed. The limit for Zoom is an eight point block.

Unzoom

Returns a Zoomed block to its original trace size.

Line List

Line List provides a method to easily create trapezoidal (series of line segment) waveforms by entering a list of vertices directly from the front panel without using the waveform cursor on the oscilloscope (as the Line Draw tool requires).

2.2.3 Operational Modes

CONTinuous:

The selected waveform is output continuously at the programmed frequency, amplitude, and offset. The sync marker is output once per waveform (selectable as a pulse at the start of the waveform or as a zero-crossing output of the waveform) and, except for Standard waveforms, the position marker is output at any selected point(s) of the waveform.

Standard waveforms are synthesized using a 50 MHz sample rate, and the desired waveform frequency is set by adjusting the number of points in the waveform. Frequency resolution for Sine, Square, and Haversines is 8 digits limited by 1 µHz, 5 digits for frequencies >20 MHz. Frequency Resolution for Ramps, Triangle, and Sinc is 8 digits limited by 1 µHz, 5 digits for frequencies ≥100 kHz. The appropriate filter is automatically selected. When a user-defined arbitrary waveform is selected, the sample frequency is set in the range of 0.1251 Hz to 50 MHz with 5 digit resolution. The sample frequency is the desired waveform frequency multiplied by the number of points in the waveform. No Filter is selected. For details, refer to paragraph 2.2.6, Frequency.

For remote (SCPI) programming, select Continuous mode by setting INITiate:CONTinuous ON and [SOURce:]FREQuency:MODE to CW or to FIXed. Then frequency is determined by the TRACe MODE (CW or RASTer), programmed FREQuency value (CW waveform frequency or RASTer sample clock frequency), and ROSCillator SOURce (INTernal, BUS, or EXTernal clock source). For SCPI details, refer to Appendix C.

TRIGgered:

Waveform output is quiescent at first data point of selected trace until a triggering event (selectable by TRIGger SOURce), after which a single waveform at the programmed frequency, amplitude, and offset is initiated. The waveform completes the number of cycles set by the TRIGger COUNt and returns to its quiescent baseline value for another triggering cycle. The triggering baseline is the level of the first waveform address. Frequency resolution is 5 digits and maximum frequency is 10 MHz for all waveforms. For details, refer to paragraph 2.2.12, Triggering.

For remote (SCPI) programming, select Trigger mode by setting INITiate:CONTinuous OFF and TRIGger:GATE OFF. Set TRIGger:COUNt to the desired value of repeat cycles. For SCPI details, refer to Appendix C.

GATE:

Same as Triggered, except output is continuous for duration of gate signal. Last waveform cycle is always completed when gate signal is removed.

For remote (SCPI) programming, select GATE mode by setting INITiate: CONTinuous OFF and TRIGger:GATE ON. For SCPI details, refer to Appendix C.

AM/SCM:

Operates as in Continuous Mode above, except that the output can be Amplitude Modulated or Suppressed Carrier Modulated by external signals. For details, refer to paragraph 2.2.13, Modulation.

For remote (SCPI) programming, select AM/SCM mode by setting [SOURce:]AM ON and [SOURce:]AM:MODE to AM or to SCM.

SWEep:

Operates as in Continuous Mode above, except that the output frequency can be swept by an internal sweep generator between programmed start and stop frequencies.

Clock Input/Output BNC (>1 kΩ / 50Ω)

Selectable as either TTL level clock input or TTL level clock output:

Configured as an input:

Clock input used as waveform sample clock can range from DC to 50 MHz. Maximum allowable input is ±15V.

Amplitude Range:	TTL levels; V_{IHmin} = 2.1V, V_{ILmax} = 0.8V
Min Pulse Width:	20 ns

Configured as an output:

TTL Clock output is 0.1251 Hz to 50 MHz waveform sample clock in normal operation and 0.1251 Hz to 100 MHz in Clock mode. The output is protected against short circuits to ground.

Resolution/Accuracy:	Same as the frequency synthesizer.
Levels:	Low level < 0.5V into 50Ω
	High level > 2.1V into 50Ω
Rise and Fall time:	<3 ns into 50Ω

Sync Marker Output BNC (50Ω)

TTL compatible pulse into 50Ω at the waveform frequency. Sync generation technique is selectable as "ZCROss" or as "BBITs". Protected against short circuit to ground.

Levels:	Low level < 0.5V into 50Ω
	High level > 2.1V into 50Ω
Rise and Fall time:	<7.5 ns into 50Ω

If ZCROss is selected, the sync is generated from zero-cross detecting (independent of DC offset) the waveform. The sync marker is a TTL high whenever the waveform is positive. This is the default and preferred selection for standard waveforms except haverwaves (when TRACe MODE is set to CW).

When BBITs is selected, the sync marker is a TTL high for a variable number of samples (minimum of two sample periods; refer to the position marker description for explanation) starting at the first waveform memory location used. This is the default for user-defined arbitrary waveforms (when TRACe MODE is RASTer). However, either sync technique is applicable, depending upon the waveform characteristics.

Position Marker Output BNC (50Ω)

TTL compatible pulse into 50Ω. User-programmable position markers for use with user-defined waveforms. User can clear the markers low at all points or set the marker high at any point in a trace. Protected against short circuit to ground.

A marker set at address zero will be true during the trigger quiescent baseline. If address 1 is set (and zero is not), the position marker output follows the trigger event plus the pipeline delay.

The position marker is one waveform data point (not necessarily 1 clock) wide for each location selected. In CW mode, for high frequency waveforms, a data point may not be accessed during each pass through the waveform. For very low frequencies each point may be sampled for a number of clock cycles.

Levels:	Low level < 0.5V into 50Ω High level > 2.1V into 50Ω
Rise and Fall time:	<7.5 ns into 50Ω

2.2.4.3 Backplane (Intermodule) I/O

The Model 295 chassis contains a backplane with the connectors and signal interconnections for the arb channels. Some of these interconnections serve to support operation of multiple channel cards in series or in parallel, where intermodule signal routing is handled automatically using the backplane. These signals consist of Triggers, Clocks, Phase information, and analog SUMBUS signals. For more information refer to paragraph 2.2.14, Interchannel Operation.

2.2.5 Waveform Characteristics

Square Transition Time:

For ≤10 Vp-p:	<9.0 ns
For > 10 Vp-p:	<9.5 ns
Square Aberrations:	<(5% +20 mV)

Square Symmetry: (0°C to +50°C)

< 10 MHz:	50% ±1%
≥ 10 MHz:	50% ±2%

Sine Distortion: (Max Harmonic Level, Elliptic Filter)

<100 kHz, ≤ 15 Vp-p:	-60 dBc
<5 MHz, ≤10 Vp-p:	-45 dBc
<5 MHz, >10 Vp-p:	-40 dBc
≤20 MHz, ≤10 Vp-p:	-35 dBc
≤20 MHz, >10 Vp-p:	-28 dBc

Intermodulation Products: (Max Spur level, Elliptic Filter)

<5 MHz:	- 60 dBc
<10 MHz:	- 50 dBc
≤20 MHz:	- 35 dBc

2.2.6 Frequency

Frequency Accuracy

<±2 ppm over a range 0°C to +50°C temperature (internal reference)

Frequency, Standard Waveforms

Range:	1 µHz to 20 MHz (Sine and Haversines), 1 µHz to 25 MHz (Square), 1 µHz to 2 MHz (all others - 25 point waveform minimum).

Resolution:	Sine, Square, and Haversines: 8 digits limited by 1 µHz, 5 digits for frequencies >20 MHz. Ramps, Triangle, and Sinc: 8 digits limited by 1 µHz, 5 digits for frequencies ≥100 kHz.

Frequency, Arbitrary Waveforms

Range:	0.1251 Hz to 50 MHz Sample Rate
Resolution:	5 digits limited by 0.1 mHz; Minimum waveform length, 5 Points.

Frequency, Clock Output

Range:	0.1251 Hz to 100 MHz
Resolution:	5 digits

2.2.6.1 Arb Clock and Waveform Timing:

CW (Phase Accumulate) Mode:

Waveform is generated by a phase accumulator. Standard waveforms occupy a fixed 4k block of points and are output in CW playback mode. If standard waveforms are selected in triggered or gated mode of operation, the clock frequency resolution is reduced from eight to five digits.

Raster Mode:

User-defined waveforms are generated by scanning through each point in the trace, one clock cycle per point. User waveforms can have horizontal resolution from 5 points to 32k (128k optional) points. The internal raster clock frequency is programmable from 125 mHz to 50 MHz with 5 digits resolution, limited by 0.1 mHz. Waveform frequency is calculated by dividing clock frequency by the number of points in the trace.

2.2.7 Amplitude

Range:	0.015 to 15 Vp-p into 50Ω: 0.03 to 30 Vp-p into >10 kΩ
Resolution:	3.5 digits
Accuracy:	Greater of ±1% of setting or the following limit:

Peak Amplitude		+ABS(Offset)	Limit
>2.500V	to	≤7.500V	±15 mVp
>1.250V	to	≤2.500V	±7.5 mVp
>625 mV	to	≤1.250V	±3.75 mVp
>312.5 mV	to	≤625.0 mV	±2 mVp
>156.3 mV	to	≤312.5 mV	±1 mVp
>78.13 mV	to	≤156.3 mV	±500 µVp
>39.06 mV	to	≤78.13 mV	±250 µVp
	to	≤39.06 mV	±125 µVp

Monotonicity: 0.2%

Flatness relative to 1 kHz: (Elliptic filter selected, non sweep modes).

	25°C ±10°C	0 to 50°C
Freq < 5 MHz	±2%	±5%
Freq ≤ 20 MHz	±5%	±10%

2.2.8 Offset

Range:	±7.5V into 50Ω; ±15V into >10 kΩ
Resolution:	3.5 digits
Accuracy:	Greater of ±1% of setting or limit listed below.

Peak Amplitude + ABS(Offset)			Limit
>2.500V	to	≤7.500V	±15 mVp
>1.250V	to	≤2.500V	±7.5 mVp
>625 mV	to	≤1.250V	±3.75 mVp
>312.5 mV	to	≤625.0 mV	±2 mVp
>156.3 mV	to	≤312.5 mV	±1 mVp
>78.13 mV	to	≤156.3 mV	±500 µVp
>39.06 mV	to	≤78.13 mV	±250 µVp
	to	≤39.06 mV	±125 µVp

2.2.9 Filtering

Three filtering selections:

20 MHz, 4 pole Bessel
20 MHz, 7 pole, 6 zero Elliptic
No filter

2.2.10 Linked Sequence Operation

Linked Sequence mode provides the ability to link multiple arbitrary waveforms together into a long and complex waveform sequence. Each waveform becomes a waveform segment of the overall sequence. Each segment is assigned a unique loop count with a programmable advance event to the next segment in the sequence. The total number of data points in all waveform segments of an active sequence may not exceed the installed waveform memory size (refer to Horizontal Resolution in User-Defined Waveforms section). Additionally, two channels may be linked together via interchannel triggering and summing to double the effective sequence length.

Waveform Segments:	2 to 4 per channel
Segment Loop Count:	1 to 65,535 or continuous
Start Conditions:	Immediate or selected start trigger event.
Advance Conditions:	Loop done OR Loop continuously until selected advance trigger event true OR Loop done and advance trigger true.
Advance Trig Types:	Event - Trigger must transition to the true state to qualify as an event. Trigger event is latched. Level - Trigger must be in the true state to initiate an advance. Trigger is not latched.
Advance Types:	Synchronous - Current segment is completed before next segment starts. Asynchronous - When advance conditions are met, next segment is started immediately. Current segment is not completed.
Sequence Modes:	Continuous or Triggered (1 to 524,287)

AM Scale Factor: Proportional to programmed amplitude -Peak Amplitude + Abs(Offset)

Ratio of programmed Vout to Vin for 100% AM

>2.500 to ≤7.500 V	10:1
>1.250 to ≤2.500 V	5:1
>0.625 to ≤1.250 V	2.5:1
>312.5 to ≤625 mV	1.25:1
>156.3 to ≤312.5 mV	0.625:1
>78.13 to ≤156.3 mV	0.3125:1
>39.06 to ≤78.13 mV	0.1563:1
to ≤39.06 mV	0.07813:1

SCM Scale Factor: 5 V/V.
Scale Factor Accuracy:
±5% for carrier ≤5 MHz
±20% for carrier >5 MHz

NOTE *All scale factors assume main output 50Ω load.*

2.2.14 Interchannel Operation

Interchannel Analog Summing:

Waveform Summing sums the waveform from any one channel into the output of any or all remaining channels. The scale factor from the source channel's amplitude/offset setting to the preattenuated amplitude/offset of the receiver channel is 1:1. Output attenuators on receiver channels are selectable:

Attenuation, dB	Division, ratio
0	1/1
-6	1/2
-12	1/4
-18	1/8
-24	1/16
-30	1/32
-36	1/64
-42	1/128

Amplitude Accuracy at 1 kHz: ±5%
3 dB Bandwidth: >12 MHz

Interchannel Phase Control

Two or more channels can be assigned a fixed phase relationship. The "Slave" module must be driven by the "Master's" clock generator, and the waveforms must be of the same length and frequency. Any change in phase angle between channels will require one waveform cycle to reacquire phase lock. Phase control signals use the backplane.

	User Waveforms	Standard Waveforms
Phase Resolution:	360°/# points	0.1°
Phase Accuracy:	±Time Skew	±(0.05° + Time Skew)
Interchannel Time Skew:	< ±10 ns	

Interchannel Triggering

Arb channels can also use the chassis backplane to daisy chain a trigger signal from the Start channel, through a number of channels in the Chain to the End channel. Each channel receives the triggering signal on the backplane from the previous channel, and drives the backplane with its selected Trigger Source to the next channel. The End channel can be set up to drive the backplane with its selected Trigger Source back to the Start module, closing the loop.

In this fashion, complex and versatile interchannel triggering schemes can be set up. Each channel can have its trigger source (the signal that it uses to drive the backplane) and its output waveform set up independently. Trigger sources include BIT (pulse occurring at the end of a trace), Burst Complete, or Loop Complete.

2.2.15 Clocks

The waveform sample rate clocks for the arb channels can be independent or synchronized to a single clock source, as follows:

Sample Clock Sources

Channel clock generator(s):	0.1251 Hz to 50 MHz
Channel external clock input:	DC to 50 MHz
System clock generator:	Derived from any channel's internal clock generator or its external clock input

NOTE *Clock source for each channel is independently selectable.*

For standard functions (Trace Mode CW) the waveform sample frequency (and thus the clock output from the master) is 50 MHz fixed. For user-defined waveforms (Trace Mode Raster) sample frequency is selectable, and the Master's clock output will vary between 25 MHz and 50 MHz with the mantissa of the frequency ([SOURce:] FREQuency: RASTer) parameter.

2.2.16 Options

The standard configuration includes a single arb channel and a two button mouse. Options supported include:

001 Additional 50 MHz Arb Channel Module

One module is included with the standard instrument. Up to three additional channels (modules) can be added for a total of four channels in the unit.

001-EM Additional 50 MHz Arb Channel Module

Same as above except channel memory is extended to 128k points from standard 32k points of horizontal resolution.

002 3.5" Floppy Disk Drive

Used for waveform data storage, 1.44 MByte format, MS-DOS compatible. Recommended for configurations of two or more arb channel modules. Wavetek's WaveForm DSP™ file format is Model 295 compatible and is loaded using Option 002.

004 Rack Mount/Chassis Slides

Used for mounting the chassis in a standard 19 inch EIA equipment rack. Occupies 5 1/4 inches of rack height (refer to Appendix E of this manual).

005 Direct DSO Download

Option consists of a 3 1/2 inch floppy diskette (must include Option 002) with software drivers for uploading waveform data files from commercial digital storage oscilloscopes (DSO's). DSO models supported and additional information is located in Appendix F of the Model 295 Operator's Manual.

007 High Voltage Module

Provides high voltage output connector and an external analog summing input connector for each arb channel up to a system limit of three arb channels. Routing of the waveform to High Voltage module is internal (programmable). The High Voltage module must be installed in the channel 4 position. Refer to Appendix B of this manual for additional information. Specifications apply for a 500Ω load at 80 Vp-p:

Amplitude range:	10 Vp-p to 100 Vp-p
Amplitude accuracy:	± 5% of setting
Amplitude Resolution:	<0.3 Vp-p
Output Current	100 mA per output
	<210 mA all three outputs
Max. slew rate:	>200 V/µs
3 dB bandwidth:	>700 kHz Internal
	>700 kHz External Summing Input
Square transition time:	< 400 ns
Square aberrations:	< 5% ± 100 mVp-p
Square symmetry:	< 200 kHz; 50% ± 2%
Sine distortion:	<1 kHz, ≤80 Vp-p: No Harmonic > -35 dBc
	<1 kHz, ≤80 Vp-p: No Harmonic > -58 dBc
	<10 kHz, ≤80 Vp-p: No Harmonic > -45 dBc
DC offset	≤±200 mVdc into 500Ω

High Voltage Inputs and Outputs

High Voltage Out (5Ω)	100 Vp-p max. into 500Ω. Output protected against short circuits to ground.
Ext Sum In (1.3 kΩ)	10 Vp-p input level produces 100 Vp-p output. Inputs >5 Vpk (as in the case of offset amplitudes) clip the waveform's peak. Clipping will not harm the High Voltage Module. Gain Ext In to Output: -10 V/V ± 4%.

2.2.17 AutoCal/Calibration

Each 295 arb module contains DC measurement capability. This feature provides the ability to conduct a limited Autocal and self diagnostic. Some parts of the calibration (e.g., filter flatness) require the use of external measurement equipment. The calibration data is stored in EEPROM on each arb channel module. The processor accesses the data and uses it to correct the output as required to maintain the specified performance.

NOTE *Performance specifications apply within the specified environmental conditions after a 20 minute warm up period. Specifications are subject to change without notice.*

2.3 GENERAL

2.3.1 Front Panel Interface

The front panel contains a 320 x 200 pixel Liquid Crystal Display (LCD) that supports a Graphical User Interface (GUI). Data entry is via the 42 keys on the front panel and/or the provided mouse.

2.3.2 Remote Interface

The Model 295 arb adheres to the Standard Commands for Programmable Instruments (SCPI) remote programming format Version 1992.0, February 1992 (refer to Appendix C of the model 295 Operator's Manual for conformance information and the SCPI manual for further information). SCPI is an industry standard language for remote instrument programming. It addresses a variety of test and measurement instrument requirements. Using the provided IEEE-488.1 (GPIB) and RS-232 interfaces, the Model 295 arb can be controlled using the SCPI language and the appropriate controller. Root level commands include:

OUTPut	**SOURce**	**STATus**	**SYSTem**
TRIGger	**CALibration**	**INITiate**	**RESet**
TEST	**TRACe**		**MMEMory DISPlay**
HVOLtage			

Model 295 also supports all IEEE-488.2 Common Commands mandated for use with SCPI.

2.3.3 Physical

Dimensions

Width:	16.75 in (42.55 cm)
Height (with Feet):	5.82 in (14.79 cm)
Height (Rack Mount):	5.22 in (13.26 cm)
Depth (Overall):	18.00 in (42.87 cm)

Weight

Basic unit (1 Channel):	25.5 lbs (11.6 kg)
Arb Channel Module:	2.4 lbs (1.1 kg)
Floppy Disk Drive Kit:	1.1 lbs (0.5 kg)

Power

< 60 VA plus 60 VA per channel

Line Voltage: 90 to 253 Vac, 47 to 63 Hz

2.3.4 Environmental

MIL-T-28800D for type 3, class 5, except as noted

Temperature Range:	±10°C of AutoCal for specified operation except as otherwise noted; operates 0°C to 50°C maximum range; storage limits are -20°C to +71°C
Warm-up Time:	20 minutes for specified operation
Altitude:	Sea level to 10,000 feet for operation; sea level to 15,000 feet for storage.
Relative Humidity:	0 to +10°C: Not Controlled (non-condensing).
	+11 to +30°C: 95±5% relative humidity max.
	+31 to +40°C: 75±5% relative humidity max.
	+41 to +50°C: 45±5% relative humidity max.
Reliability:	>4000 hours MTBF at 25°C ground benign (1 Channel System);
	>2500 hours MTBF at 25°C ground benign (4 Channel System & w/o disk, mouse).
	MIL-HDBK-217 calculation at 50% component stress.
	Calibration interval > 12 months
Shock/Vibration:	40G max. / Sinusoidal of 5 to 55 Hz with 2G max.
Safety:	Designed and tested to the requirements of IEC-348.

3.1 INTRODUCTION

This section covers routine tasks that Service Technicians may perform on the Model 295.

3.1.1 Alignment

Section 4 of this manual contains both Performance Verification and Alignment Procedure instructions.

AutoCal (automatic calibration) provides a quick method of calibrating the Model 295 without the use of external test equipment. AutoCal automatically sets up the instrument and takes internal measurements using internal standards. Model 295 calculates correction values and stores those values in memory. Model 295 recalls and loads these correction values at power up. Use AutoCal when Model 295 accuracy is critical, after long term instrument storage or following drastic changes in the environment. Also, perform AutoCal at any time you believe necessary.

The Alignment Procedure provides a more extensive method of Model 295 calibration. The Alignment Procedure uses external test equipment and requires opening the instrument for adjustments. Use the Alignment Procedure when the Model 295 displays "CAL REQUIRED" or "FAILED AUTO CAL", after repair, after Performance Verification procedure failure, or at routine scheduled calibration.

3.1.2 Fuse Replacement

To replace the Model 295's fuse (rear panel), use the following instructions.

1. Disconnect the power cord at the instrument. Open the fuse holder cover door. Rotate the fuse pull to the left to remove the fuse; refer to figure 3-1.

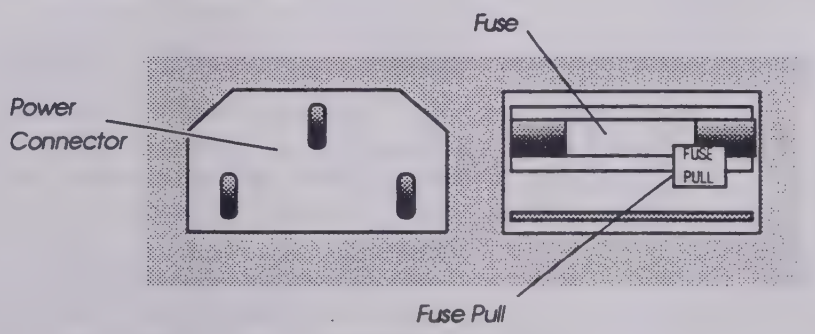


Figure 3-1. Power Input Plug and Fuse

2. Replace the fuse with one having the same current and voltage ratings.

Input Voltage	Fuse Ratings
90 to 126	4A, 125Vac, Slo Blo
198 to 252	4A, 250Vac, Slo Blo

Rotate the fuse pull lever back into the normal position. Insert the correct fuse in the fuse holder. Close the fuse holder cover door.

3. Connect the AC line cord to the mating connector at the rear of the unit and power source.

3.1.3 Battery Replacement

Model 295 contains a Lithium battery (Panasonic BR-2/3A or equivalent) to power the unit's memory when power is off. This battery life is typically greater than three years. At power on, Model 295 checks the battery's condition as part of the power-on self-test. If self-test detects a low battery, the display shows "LOW BAT X.XXXV". Replace the battery; otherwise the contents of the memory could be lost when power is turned off.

To replace the battery,

1. Turn the instrument OFF and remove all power by disconnecting the rear panel power cord.
2. Remove the top cover by removing the two (2) screws located on the top right and left hand corners of the rear panel. Lift the rear of the top cover slightly and slide cover to the rear and off.
3. Remove the bottom cover by removing the two (2) screws located on the bottom right and left hand corners of the rear panel. Lift the rear of the bottom cover slightly and slide cover to the rear and off.
4. Remove the top shield by removing the nine (9) screws in the top shield.

WARNING *With the instrument top shield removed, dangerous voltages can be present on the power supplies used in the model 295. Even if the power is turned off and the power cord removed these voltages may still be present.*

5. Remove the left side cover by removing the two (2) screws located on the left hand side of the rear panel. Move the rear of the side cover out slightly and slide side cover to the rear and off.
6. Remove the right side cover by removing the two (2) screws located on the right hand side of the rear panel. Move the rear of the side cover out slightly and slide side cover to the rear and off.
7. Remove the front panel assembly by removing the two (2) screws located on the front of the left side and two (2) screws located on the front of the right side of the instrument. Lift the front panel assembly forward and down just enough to allow access to the battery.

8. Install the rear panel power cord and turn the instrument ON.
9. With the power ON, remove the old battery and replace it with a new battery. Observe the polarity of the battery when installing it.

NOTE *If the power is turned off while replacing the battery, all contents of the RAM will be lost.*

10. After replacing the battery, turn the instrument first OFF and then back ON. If the power-on self-test does not give a low battery indication the battery replacement is complete. Turn the instrument OFF and remove all power by disconnecting the rear panel power cord.
10. Replace the front panel assembly and install the two (2) screws located on the front of the left side and two (2) screws on the front of the right side of the instrument.
11. Replace the right side cover and install the two (2) screws located on the right hand side of the rear panel.
12. Replace the left side cover and install the two (2) screws located on the left hand side of the rear panel.
13. Replace the top shield and install the nine (9) screws in the top shield.
14. Replace the bottom cover and install the two (2) screws located on the bottom right and left hand corners of the rear panel.
14. Replace the top cover and install the two (2) screws located on the top right and left hand corners of the rear panel.

3.1.4 Fan Maintenance

Fan maintenance is limited to cleaning (dust and lint removal) and checking the rotors for excessive bearing wear.

1. Turn the instrument OFF and remove all power by disconnecting the rear panel power cord.
2. Remove all of the arb channels from the instrument.
3. Remove the top cover by removing the two (2) screws located on the top right and left hand corners of the rear panel. Lift the rear of the top cover slightly and slide cover to the rear and off.
4. Remove the top shield by removing the nine (9) screws in the top shield.

WARNING *With the instrument top shield removed, dangerous voltages can be present on the power supplies used in the model 295. Even if the power is turned off and the power cord removed these voltages may still be present.*

5. Using your fingers, check the rotor of each of the fans for side-to-side looseness.
6. Check that both fans spin freely and do not bind.

WARNING *The following step requires the use of adequate eye protection.*

7. Using low pressure air blow out all of the dust and lint buildup on the fan blades and the power supplies.
8. Replace the top shield and install the nine (9) screws in the top shield.
9. Replace the top cover and install the two (2) screws located on the top right and left hand corners of the rear panel.
10. Reinstall all of the arb channels in the instrument.

4.1 VERIFICATION TESTING

This document defines the minimum testing necessary to verify with reasonable certainty that the Model 295 is totally functional and operating within specified limits. Familiarity with Model 295 operation and the ability to set up and operate general purpose test equipment are assumed for personnel using this document.

Note that the arb channel test section specifies the required tests for one arb channel module. All arb channels must be tested to ensure conformance to specifications.

4.1.1 Standard Test Equipment

The following list of test equipment is included in this document for reference only. Substitution of any equipment is allowed as long as adequate measurement accuracy is maintained. Test equipment and test methods should always provide at least 5 times better measurement accuracy than the specification of the parameter being tested.

Only equipment that has been properly serviced and calibrated (traceable to NBS) according to the manufacturer's specifications may be used for performing acceptance testing.

Accessory equipment such as coax cables and terminations are not listed here. Use of appropriate accessories for the type of test being performed is assumed. If an accessory item is critical to the accuracy of a measurement, its requirements will be defined in the test procedure.

Salient characteristics of the equipment listed below are not specified. If substitution of equipment is desired, a review of the test procedures must be made to ensure that the substitute has all salient characteristics.

Signal Sources:	Wavetek Model 650 Variable Phase Synthesizer
	Wavetek Model 91 Synthesized Pulse/Function Generator
Universal Counter:	HP 5334B
Digital Multimeter:	Datron Model 1062
Digitizer: (Automated testing)	HP 54100A or Tektronix 11402 w/ 2 ea 11A71 or 1 ea 11A72 plug-ins installed.
Distortion Analyzer:	HP Model 8903E
Oscilloscope: (Manual testing)	Tektronix Model 2465B
Spectrum Analyzer:	HP 70000 system which includes:
	HP 70001A Mainframe
	HP 70205A Graphics Display
	HP 70900A Local Oscillator
	HP 70902A IF Section (10 Hz to 300 kHz)
	HP 70904A IF Section (100 Hz to 2.9 GHz)
	HP 70903A (Option 004) IF Section (100 Hz to 3 MHz)
RF Voltmeter:	Boonton Model 9200B
3 Loads, shunt:	10 Watt, 500 ohm ±0.1%
1 Load:	450Ω in series ±0.1%, 10 Watt
1 Load:	475Ω in series, 50Ω in shunt, ±0.1%, 10 Watt

4.1.2 Standard Test Conditions

Temperature:	25°C ±10°C
Humidity:	10% to 90%
Altitude:	Sea Level to 2,000 ft. (610 m)

4.1.3 Chassis Tests

Some tests of the chassis resources require the installation of four channel modules. It is assumed that four working channel modules are installed. Many tests refer to a channel setup. Unless otherwise specified, this setup can be applied to any installed channel module.

4.1.3.1 REF Output Test

Purpose: Verify the accuracy of the Model 295 internal 10 MHz Reference Oscillator and functionality of the output circuits.

Spec: Reference Freq Accuracy; 10 MHz ±2 ppm.

Reference Output Levels; >2.0V high level, <0.8V low level.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Ref In/Out connector to the frequency counter input and terminate with 50Ω.

Press the Instrument key on the Model 295 front panel.

Press the 10 MHz Reference menu selection key.

Press the Output menu selection key to set the Model 295 for Ref Output.

Using the frequency counter, verify that the frequency of the Model 295 is within specs.

Connect the Model 295 Ref In/Out connector to the oscilloscope and terminate with 50Ω.

Verify that the amplitude of the Model 295 is within specs.

4.1.3.2 REF Input

Purpose: Verify the functionality of the reference input, reference band-pass filter and reference detector.

Spec: TTL Level or ≥1 Vp-p Input. Accepted if 10 MHz ± < 10%, rejected if 10 MHz ± > 20%.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Input a 1 Vp-p, 10 MHz sine wave to the Model 295 10 MHz Ref In/Out connector from the external frequency reference generator.

Press the Instrument key on the Model 295 front panel.

Press the 10 MHz Reference menu key.

Press the Input menu selection key to set the Model 295 for Ref In.

Using the frequency counter verify that the arb channel output frequency is within specs.

Reset the external frequency reference generator to 10.5 MHz and verify that the arb channel frequency tracks input.

Reset the external frequency reference generator to 13 MHz and verify that the arb channel frequency does not track the external input frequency.

4.1.3.3 System Trigger Input Level/Slope Test

Purpose: Test the Trigger Input comparator, the level control, and the slope control.

Spec: ±10V threshold range, slope selectable. Threshold Accuracy ±0.4V.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect an external trigger source to the Model 295 chassis System Trigger Input connector.

Apply a ±1 Vpk, 1 kHz sine wave to the Model 295 System Trigger Input connector.

Connect an oscilloscope to the Model 295 arb channel Main Out connector.

Press the Channel key on the Model 295 front panel.

Select the Frequency box and set the channel frequency for 100.00 kHz.

Select the Mode box and click on the Gate menu selection to set the Model 295 arb channel to the Gated mode

Press the front panel Trigger key.

Change the Gate selection to System Trigger Input BNC.

Select the Menu box in the upper right corner of the display.

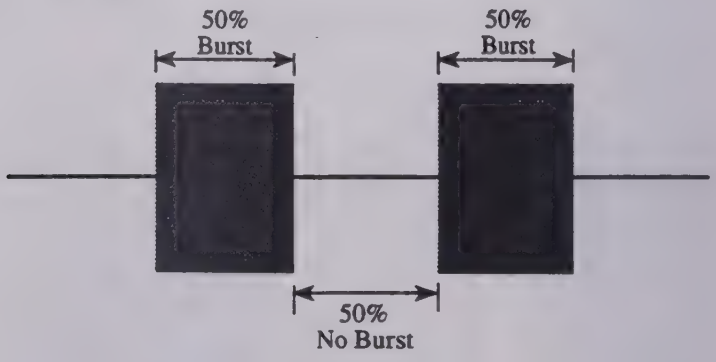
Select System Trigger Level from the display menu selections, then set the trigger level to 0.0V and click on Done.

Reselect the Menu box and select Channel Trig Polarity.

Set the polarity to Positive slope.

Apply a ±1 Vpk, 1 kHz sine wave to the Model 295 Trigger Input connector.

Verify an approximate 50% tone burst signal at the selected Model 295 arb channel output connector.



4.1.3.4 Z-Axis Output

Purpose: Test the level control of the Z-Axis output.

Spec: Adjustable 0 to 9.4 Vpk ±(10% +100 mV) pulse, polarity selectable.

Negative Level Control:

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Press the front panel Waveform key.

Select Edit from the display menu.

Select the stored waveform called TEST.WFM from the list that appears.

Select Done at the bottom of the display screen menu.

Select Begin Edit on the next display screen to appear.

Select MENU on the next display screen (upper right corner) to appear.

Select Z-Axis in the screen that appears.

Set the Z-Axis polarity to negative.

Set the Z-Axis level as follows and measure the DC voltage of Z-Axis Out connector terminated into ≥ 1 MΩ.

Set Value	Min Spec Level	Max Spec Level
9.4	-8.36V	-10.34V
0.0	+0.10V	-0.10V

Positive Level Control:

Setup: Change the Z-Axis polarity to positive and measure the DC voltage of the Z-Axis Out connector terminated into ≥ 1 MΩ.

Set Value	Min Spec Level	Max Spec Level
9.4	+8.36V	+10.34V
0.0	-0.10V	+0.10V

4.1.3.5 Horizontal Sweep Output Levels Test

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the DMM input to the Model 295 Horiz Sweep Out connector.

Set the DMM to measure a range of 0 to 15 VDC.

Press the front panel Channel key.

In the display that appears, set the Model 295 arb channel Mode to Sweep Hold.

Press the front panel Trigger key.

Select Sweep Start in the display that appears.

Select System Trigger Input BNC from the menu that appears.

The Horiz Sweep Output is set for an initial default of Stop.

Measure the DC voltage at Horiz Sweep Out terminated into > 1 MΩ.

Press the Manual Trigger key to measure the Start voltage.

Set Freq	Min Level	Max Level
Start	–0.1 Vdc	+0.1 Vdc
Stop	+9.8 Vdc	+10.2 Vdc

4.1.4 Arb Channel Tests

Repeat for each installed arb channel module.

4.1.4.1 Self Test

Purpose: Test basic integrity of the arb channel circuits and also the interface to the backplane.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Press the front panel Instrument key.

Select Test/Cal from the displayed menu.

Select Self Test from the next menu.

Up to four (4) check boxes will be displayed, depending on the number of installed arb channels. Select one or more by clicking on the check boxes, then click on the Done box.

Initiate a self test sequence.

Verify that the Model 295 Self Test returns a zero (shown in both Hex and Decimal) indicating a successful self test.

4.1.4.2 Phase Accumulated Frequency Accuracy

Purpose: Test the Phase Accumulator functionality and programmability.

Spec: ≤ 0.2 ppm error relative to reference frequency.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Place a BNC double female "T" connector on the frequency counter Ext Ref Input connector.

Set the frequency counter for external reference operation.

Connect the external reference generator output to the frequency counter Ext Ref Input connector BNC "T".

Connect the Model 295 Ext Ref Input to the frequency counter Ext Ref Input connector BNC "T".

Connect the Model 295 Sync Marker Output to the frequency counter Input connector.

Set the frequency counter to measure a frequency of approximately 17 MHz with at least 8 digits of resolution.

Set the external reference frequency generator for an output of 10.000 MHz, sine wave, 2 Vp-p amplitude.

Set the Model 295 for external reference operation by pressing the front panel Instrument key, and then select the last item (10 MHz Reference) from the menu that appears. Select Input from the next menu and then select Done.

Set the Model 295 arb channel output by pressing the front panel Channel key In the menu that appears, set the channel frequency to 17,704,010. Set the channel output to On, the Mode to continuous, the Function to sine, and the Ampl: to +1.00 Vpk.

Measure the frequency of the Sync Marker output terminated into 50Ω.

Set 295 Value	Min Cntr Value	Max Cntr Value
17,704,010 Hz	17,704,006.5 Hz	17,704,013.5 Hz

4.1.4.3 Raster Scan Frequency Accuracy

Purpose: Test the Synthesizer and the Clock Prescaler functionality and programmability.

Spec: ≤ 0.1 ppm error relative to reference frequency.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Place a BNC double female "T" connector on the frequency counter Ext Ref Input connector.

Set the frequency counter for external reference operation.

Connect the external reference generator output to the frequency counter Ext Ref Input connector BNC "T".

Connect the Model 295 Ext Ref Input to the frequency counter Ext Ref Input connector BNC "T".

Connect the Model 295 Sync Marker Output to the frequency counter Input connector.

Set the frequency counter to measure a frequency of approximately 10 MHz with at least 8 digits of resolution.

Set the external reference frequency generator for an output of 10.000 MHz, sine wave, 2 Vp-p amplitude.

Set the Model 295 for external reference operation by pressing the front panel Instrument key, and then select the last item (10 MHz Reference) from the menu that appears. Select Input from the next menu and then select Done.

Using the Model 295 and the procedure below, define a 5-point waveform using raster scan clocking.

Press the Model 295 front panel Waveform key.

Select New from the menu.

Enter "Wave1" in the Waveform Name box (use the mouse

to select the correct letters and numbers).

Enter "5" in the Waveform Points box.

Click on the Done box and then, in the next screen that appears, click on the Begin Editing box.

In the next screen, under the absolute column, set the BLOCK Length to "5".

In the box at the bottom of this screen, click on Math.

In this new screen, click on sin in the Function List box.

Select sin from the menu list.

The incomplete math expression "sin (t" appears in the edit box. Complete the expression by adding the closing ")" after the "t" and then clicking on the Done box.

End the editing session by pressing the front panel Channel key. When prompted to save the waveform, select Store in Battery-Backed RAM and then click on Done.

NOTE *The Function box in the Channel Setup screen will now display the file name WAVE1.WFM and the Freq: box will display 50 MHz (Smpl). This is the Master Scan Mode.*

Program both the Ext. Ref. Generator and the Model 295 waveform frequency/period as follows, then measure the frequency/period of Sync Marker output terminated into 50Ω.

Ext Ref Freq.	295 Freq/Period	Min Spec	Max Spec
10.00 MHz	50 MHz	9,999,999 Hz	10,000,001 Hz
10.00 MHz	25.001 MHz	5,000,199.5 Hz	5,000,200.5 Hz
10.00 MHz	1 Sec	4.9999995 Sec	5.0000005 Sec

4.1.4.4 Trigger Counter Test

Purpose: Verify the functionality and programmability of the Trigger Count circuitry.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Set the frequency counter for totalizer operation.

NOTE *Do not use Auto Trig on the counter. Experiment with the counter input Trigger Level control to find the correct trigger level setting.*

Connect the Model 295 Sync Marker Output to the frequency counter Input connector and terminate with 50Ω.

Press the front panel Channel key.

Click on the Mode box and select Triggered from the menu that appears.

Click on the Freq: box and enter a value of 1 MHz.

Click on the Function box and select sine from the menu that appears.

Click on the Output box to turn the arb channel Main Out On.

Press the front panel Trigger key.

Click on the Start box and then select System Trigger Input BNC from the menu that appears.

Click on the Count: box and enter the first count number from the following list. Press the front panel Man Trig key and verify that the number of cycles completed are within specifications.

Set 295 Count	Spec Min	Spec Max
1	1	1
370,085	370,085	370,085
1,048,575	1,048,575	1,048,575

4.1.4.5 Sine Amplitude Accuracy Test

Purpose: Verify the accuracy and the linearity of amplitude control and gain setting components.

Spec: ±1% of setting.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Set the DMM for AC RMS operation.

Connect the Model 295 Main Out to the DMM Input connector and terminate with 50Ω.

NOTE *Termination should be accurate to at least 0.1%.*

Press the Model 295 front panel Channel key.

Verify that the Function box contains the word sine. If not, click on the Function box and then select sine from the menu that appears.

Click on the Freq: box and insert "600 Hz."

Click on the Ampl: units box and then select Vrms from the menu that appears.

Click on the Output box to turn the output On.

Click on the Ampl: box and insert the following values while monitoring the DMM.

Set Value	Spec Min	Spec Max
5.303 Vrms	5.250 Vrms	5.356 Vrms
5.127 Vrms	5.075 Vrms	5.178 Vrms
4.950 Vrms	4.900 Vrms	4.999 Vrms
4.773 Vrms	4.725 Vrms	4.821 Vrms
4.596 Vrms	4.550 Vrms	4.642 Vrms
4.419 Vrms	4.375 Vrms	4.464 Vrms
4.243 Vrms	4.200 Vrms	4.285 Vrms
4.066 Vrms	4.025 Vrms	4.107 Vrms
3.889 Vrms	3.850 Vrms	3.928 Vrms
3.712 Vrms	3.675 Vrms	3.749 Vrms
3.536 Vrms	3.500 Vrms	3.571 Vrms
3.359 Vrms	3.325 Vrms	3.392 Vrms
3.182 Vrms	3.150 Vrms	3.214 Vrms
3.005 Vrms	2.975 Vrms	3.035 Vrms
2.828 Vrms	2.800 Vrms	2.857 Vrms
2.658 Vrms	2.632 Vrms	2.686 Vrms

4.1.4.6 Square Amplitude Accuracy Test

Purpose: Verify accuracy of square function gain setting components.

Spec: ±1% of setting.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Set the DMM for AC RMS operation.

Connect the Model 295 Main Out to the DMM Input connector and terminate with 50Ω.

NOTE *Termination should be accurate to at least 0.1%.*

Press the Model 295 front panel Channel key.

Click on the Function box and then select Square from the menu that appears.

Click on the Freq: box and insert "600 Hz."

Click on the Ampl: units box and then select Vrms from the menu that appears.

Click on the Output box to turn the output On.

Click on the Ampl: box and insert the following values while monitoring the DMM.

Set Value	Spec Min	Spec Max
7.500 Vrms	7.425 Vrms	7.575 Vrms
7.000 Vrms	6.930 Vrms	7.070 Vrms
6.500 Vrms	6.435 Vrms	6.565 Vrms
6.000 Vrms	5.940 Vrms	6.060 Vrms
5.500 Vrms	5.445 Vrms	5.555 Vrms
5.000 Vrms	4.950 Vrms	5.050 Vrms
4.500 Vrms	4.455 Vrms	4.545 Vrms
4.000 Vrms	3.960 Vrms	4.040 Vrms

4.1.4.7 Attenuator Accuracy

Purpose: Verify accuracy of output attenuators.

Spec: ±1% of setting.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Set the DMM for AC RMS operation.

Connect the Model 295 Main Out to the DMM Input connector and terminate with 50Ω.

NOTE *Termination should be accurate to at least 0.1%.*

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Freq: box and insert "600 Hz."

Click on the Ampl: units box and then select Vrms from the menu that appears.

Click on the Output box to turn the output On.

Click on the Ampl: box and then enter the values from the following list while monitoring the DMM.

Set Value	Spec Min	Spec Max
1.414 Vrms	1.400 Vrms	1.428 Vrms
0.7071 Vrms	0.7000 Vrms	0.7142 Vrms
0.2121 Vrms	0.2100 Vrms	0.2142 Vrms

4.1.4.8 DC Offset Accuracy Test

Purpose: Verify the DC accuracy and offset.

Spec: ±1% of setting ±5 mV.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Set the DMM for VDC operation.

Connect the Model 295 Main Out to the DMM Input connector and terminate with 50Ω.

NOTE *Termination should be accurate to at least 0.1%.*

Press the Model 295 front panel Channel key.

Click on the Function box and then select DC from the menu that appears.

Click on the Output box to turn the output On.

Click on the Offset box and then enter the values from the following list while monitoring the DMM.

Set Value	Spec Min	Spec Max
+7.500 Vdc	+7.420 Vdc	+7.580 Vdc
+5.500 Vdc	+5.440 Vdc	+5.560 Vdc
+2.500 Vdc	+2.470 Vdc	+2.530 Vdc
+1.500 Vdc	+1.480 Vdc	+1.520 Vdc
+0.500 Vdc	+0.490 Vdc	+0.510 Vdc
0.000 Vdc	–0.005 Vdc	+0.005 Vdc
–0.500 Vdc	–5.510 Vdc	–0.490 Vdc
–1.500 Vdc	–4.520 Vdc	–1.480 Vdc
–2.500 Vdc	–2.530 Vdc	–2.470 Vdc
–5.500 Vdc	–5.560 Vdc	–5.440 Vdc
–7.500 Vdc	–7.580 Vdc	–7.420 Vdc

4.1.4.9 Frequency Response Test

Purpose: Verify the amplitude verses frequency specification.

Spec: ±2% for frequencies < 5 MHz, ±5% for frequencies ≥ 5 MHz.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Main Out to the oscilloscope Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Ampl: box and enter "15 Vp-p."

If the Ampl: box does not display Vp-p, click on the Ampl: units box and then select Vp-p from the menu that appears.

Click on the Freq: box and enter "1.000 kHz."

Click on the Output box to turn the output On.

Note the 1 kHz amplitude.

Click on the Ampl: box and then enter the values from the following list while monitoring the oscilloscope. Note the amplitude variation at programmed frequencies relative to 1 kHz amplitude.

Freq	Relative Ampl
10 kHz	±2%
50 kHz	±2%
100 kHz	±2%
1.0 MHz	±2%
5.0 MHz	±5%
10.0 MHz	±5%
15.0 MHz	±5%
20.0 MHz	±5%

4.1.4.10 High Amplitude Sine Total Harmonic Distortion Test

Purpose: Verify that the sine waveform meets distortion specifications.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Main Out to the distortion analyzer Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Ampl: box and enter "15.0 Vp-p."

If the Ampl: box does not display Vp-p, click on the Ampl: units box and then select Vp-p from the menu that appears.

Click on the Output box to turn the output On.

Enter the following frequencies in the Freq: box and verify that the THD is within spec.

Set Value	Spec % Distortion
100 Hz	0.18%
1 kHz	0.18%
50 kHz	0.18%
100 kHz	0.18%

4.1.4.11 High Amplitude Sine Harmonic Levels Test

Purpose: Verify that the sine waveform meets distortion specifications.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Main Out to the Spectrum Analyzer Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Ampl: box and enter "15.0 Vp-p."

If the Ampl: box does not display Vp-p, click on the Ampl: units box and then select Vp-p from the menu that appears.

Click on the Output box to turn the output On.

Enter the following frequencies in the Freq: box and verify that the 2nd and 3rd harmonics are within the specified level relative to the level of the fundamental.

Set Value	Spec Rel Ampl
200 kHz	–40 dBc
500 kHz	–40 dBc
1 MHz	–40 dBc
2 MHz	–40 dBc
4.9 MHz	–40 dBc
5 MHz	–28 dBc
10 MHz	–28 dBc
15 MHz	–28 dBc
20 MHz	–28 dBc

4.1.4.12 Square Waveform Quality

Purpose: Verify that the Rise/Fall times and the aberrations are within specification.

Spec: Rise/Fall Time ≤ 9.5 ns for amplitudes >10 Vp-p, ≤ 9 ns for amplitude ≤ 10 Vp-p. Aberrations ≤ (5% ±5 mV) of peak-to-peak amplitude.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Main Out to the oscilloscope Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select square from the menu that appears.

Click on the Freq: box and enter "10.0 MHz."

Click on the Output box to turn the output On.

Enter the following amplitudes in the Ampl: box and verify that rise/fall and aberrations are within specs.

Set Value	Rise/Fall	Aberrations
15 Vp-p	≤ 9.5 ns	≤ 755 mVp-p
10 Vp-p	≤ 9.0 ns	≤ 505 mVp-p
5 Vp-p	≤ 9.0 ns	≤ 255 mVp-p
1 Vp-p	≤ 9.0 ns	≤ 55 mVp-p
0.5 Vp-p	≤ 9.0 ns	≤ 30 mVp-p

4.1.4.13 Squarewave Duty Cycle Test

Purpose: Verify square wave symmetry verses frequency.

Spec: 50% ±1% for all frequencies <10 MHz, 50% ±2% for frequencies ≥10 MHz.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Main Out to the oscilloscope Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select square from the menu that appears.

Click on the Ampl: box and enter "10.0 Vp-p."

If the Ampl: units box does not indicate Vp-p, click on the Ampl: units box and select Vp-p from the menu that appears.

Click on the Output box to turn the output On.

Enter the following frequencies and verify that the duty cycle is within specs.

Set Value	Spec Min	Spec Max
1 kHz	49.0%	51.0%
100 kHz	49.0%	51.0%
1 MHz	49.0%	51.0%
10 MHz	48.0%	52.0%
20 MHz	48.0%	52.0%
25 MHz	48.0%	52.0%

4.1.4.14 AM Scale Factor Accuracy Test

Purpose: Verify the scale factor accuracy of the AM circuits

Spec: 1 Vp-p = 100 ±5% at 10 Vp-p programmed amplitude.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 arb channel 1 Main Out to the spectrum analyzer signal input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

In the screen that appears, click on the Function box and then select sine from the menu that appears.

If the Ampl: units box does not indicate Vp-p, click on the Ampl: units box and select Vp-p from the menu that appears.

Click on the Ampl: box and enter "10.0 Vp-p."

Click on the Freq: box and enter "1.0 MHz."

Click on the Output box to turn the output On.

Apply a 1 kHz, 1.00 Vp-p ±1% sine signal from an External Reference Generator to the AM input connector.

NOTE *If you are using a signal source with an output impedance of 50Ω, you must terminate the signal input at the Model 295 input connector with a 50Ω termination.*

Enable AM modulation by clicking on the Channel MENU box in the upper right corner of the screen

Select Modulation from the first menu that appears and select AM from the second menu. Click on Done to return to the Channel screen.

Measure the level of one of the 1 kHz sidebands relative to the 1 MHz carrier level.

Note that the 100% modulation corresponds to a sideband level of -6.02 dBc.

Spec Min	Spec Max
- 6.47 dBc	- 5.60 dBc

4.1.4.15 Sync Marker Output Test

Purpose: Verify performance of Sync Marker Output circuits.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Sync Marker Out to the oscilloscope Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Freq: box and enter "10.0 MHz."

Click on the Output box to turn the output On.

Verify the following parameters.

Parameter	Limits
Logic high level:	> 2.1 Vdc
Logic low level:	< 0.5 Vdc
Rise Time:	< 3 ns
Fall Time:	< 3 ns

4.1.4.16 Position Marker Output Test

Purpose: Verify performance of Position Marker Output circuits.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Using the Model 295 and the procedure below, define a 5-point waveform.

Press the Waveform key on the front panel.

Select New from the menu.

Enter "5_POINTS" in the Waveform Name box (use the mouse to select the correct letters and numbers).

Enter "5" in the Waveform Points box.

Click on the Done box and then, in the next screen that appears, click on the Begin Editing box.

In the box at the bottom of this screen, click on Math.

NOTE *A blinking 0 (zero) may appear in the right end of the Math entry box. To clear it, press the front panel Clear key once, followed by the BSP key.*

In this new screen, click on sin in the Function List box.

Select sin from the menu list.

The incomplete math expression "sin (t" appears in the edit box. Complete the expression by adding the closing ")" after the "t" and then clicking on the Done box.

End the editing session by pressing the front panel Channel key. When prompted to save the waveform, select Store in Battery-Backed RAM and then click on Done.

NOTE *The Function box in the Channel Setup screen will now display the file name 5_POINTS.WFM and the Freq: box will display 50 MHz (Smpl).*

Connect the Model 295 Position Marker Out to the oscilloscope Input connector and terminate with 50Ω.

Press the front panel Waveform key and select Active from the first menu and then Active Waveform from the second menu that appears

Click on Set Markers in the Marker Position window.

Set the position marker (From) to address 0 and Length to 1 and then click on Set. The oscilloscope will display the Position Marker waveform.

Verify the following parameters:

Parameter	Limits
Logic high level:	> 2.0 Vdc
Logic low level:	< 0.5 Vdc
Rise Time:	< 8.5 ns
Fall Time:	< 8.5 ns

4.1.4.17 Clock Output Test

Purpose: Verify the performance of the Clock Output circuits.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Connect the Model 295 Clock Out to the oscilloscope Input connector and terminate with 50Ω.

Press the Model 295 front panel Channel key.

Click on the Function box and then select sine from the menu that appears.

Click on the Channel screen Menu box.

Select Clock BNC from the menu that appears.

Select High Frequency Clock Output from the next menu.

Click on the Done box.

In answer to the warning, click on Done.

Enter 1.0 MHz in the Clock Frequency box.

Set sample rate to 25 MHz.

Turn on Clock Output BNC with the Sample clock as the source.

Terminate Clock Out into 50Ω.

Verify the following parameters:

Sample Clock Out:

Parameter	Limits
Logic high level:	> 2.1 Vdc
Logic low level:	< 0.5 Vdc
Rise Time:	< 3 ns
Fall Time:	< 3 ns

4.1.4.18 Clock Input Test

Purpose: Verify performance of clock input circuits.

Setup: Perform an instrument reset to set all Model 295 parameters to their defaults by pressing the front panel Instrument key and then selecting Reset from the menu. Select Full Instrument from the next menu and Reset from the following menu.

Using the Model 295 and the procedure below, define a 5-point waveform.

Press the Waveform key on the front panel.

Select New from the menu.

Enter "5_POINTS" in the Waveform Name box (use the mouse to select the correct letters and numbers).

Enter "5" in the Waveform Points box.

Click on the Done box and then, in the next screen that appears, click on the Begin Editing box.

In the box at the bottom of this screen, click on Math.

NOTE *A blinking 0 (zero) may appear in the right end of the Math entry box. To clear it, press the front panel Clear key once followed by the BSP key.*

In this new screen, click on sin in the Function List box.

Select sin from the menu list.

The incomplete math expression "sin(t" appears in the edit box. Complete the expression by adding the closing ")" after the "t" and then clicking on the Done box.

End the editing session by pressing the front panel Channel key. When prompted to save the waveform, select Store in Battery-Backed RAM and then click on Done.

NOTE *The Function box in the Channel Setup screen will now display the file name 5_POINTS.WFM and the Freq: box will display 50 MHz (Smpl).*

Press the Model 295 front panel Channel key.

Verify that the Function box displays the waveform file name 5_POINTS.WFM that was defined in previous steps.

Click on the screen menu box and then select Clock BNC and click on Done.

Select External clock input

Connect the arb channel 1 Sync Marker Out output to the frequency counter input connector and terminate with 50Ω.

Apply a 5 MHz TTL level clock to arb channel Clock Input. Clock Input should be properly terminated to ensure good waveform quality.

Click on the screen Menu box and then select Sync Marker

Click on the On box to turn the markers on.

Verify that the Marker Out frequency = 1 MHz (a 5 MHz clock input divided by a 5 point waveform = 1 MHz.)

Set the external clock reference to the frequencies in the following list and verify the Sync Marker Out frequency.

Ext Clk Freq	Marker Out
1 MHz	200 kHz
10 MHz	2 MHz
20 MHz	4 MHz
50 MHz	10 MHZ

4.1.5 High Voltage Channel Test Specifications (Opt 007)

The tests of the High Voltage module require 3 additional channels. This test assumes the high voltage board is installed in channel slot 4, there are three additional working arb channel modules installed in the remaining slots, and the chassis is fully tested and working properly.

4.1.5.1 Sine Amplitude Accuracy Test

Purpose: Verify the accuracy and linearity of amplitude control and gain setting components.

Spec: ±5% of setting of the programmed amplitude.

Setup: Select function sine on channel board 1, 1 kHz, and 7.5 Vpk.

Terminate the High Voltage Outputs A, B, and C into 500Ω.

Termination should be accurate to at least 0.5%.

For test #1, route arb channel 1 to High Voltage output A, and perform the following measurements.

Set Value	Spec Min	Spec Max
80 Vp-p	26.87 Vrms	29.70 Vrms
72 Vp-p	24.18 Vrms	26.73 Vrms
51.5 Vp-p	17.3 Vrms	19.12 Vrms
35 Vp-p	11.76 Vrms	12.99 Vrms
19 Vp-p	6.38 Vrms	7.05 Vrms
10 Vp-p	3.359 Vrms	3.712 Vrms

For test #2, repeat test #1 using arb channel 2 and HV output B if installed.

For test #3, repeat test #1 using arb channel 3 and HV output C if installed.

For tests #4, #5, and #6, repeat test #1, #2, and #3 with the arb channel boards set to 5 Vpk.

For tests #7, #8, and #9, repeat test #1, #2, and #3 with the arb channel boards set to 2.5 Vpk.

4.1.5.2 DC Offset Test

Purpose: To verify the DC offset.

Spec: 0.0 volts ±350 mV.

Setup: On each of the three channel cards, define a 5 point arbitrary waveform with each point programmed to a value of 0.

Terminate all three of the High Voltage module outputs into 500 ohms.

Click on the Ch 1 Channel Value box and set the High Voltage output amplitude to 80 Vp-p.

Click on the Ch 1 arb channel switch to route Channel 1 to HV output A.

Measure the output on High Voltage Channel A Main Out and verify that the offset is < ±300 mV.

Repeat for channels 2 and 3 (if installed) and output B and C respectively.

Repeat for each channel at 40 Vp-p and 20 Vp-p.

4.1.5.3 Square Wave Distortion and Rise Time Test

Purpose: To verify the compliance of square wave distortion specifications.

Spec: Rise/Fall < 400 ns and < 5% +100 mVp-p aberrations.

Setup: Terminate all three of the High Voltage module outputs into 500 ohms.

On the arb channel board 1, select Square waves, 100 kHz, and 7.5 Vpk.

Click on the Ch 1 Channel Value box and set the High Voltage output amplitude to 80 Vp-p.

Click on the Ch 1 arb channel switch to route Channel 1 to HV output A.

Click on the Ch A output switch to route Channel 1 to High Voltage Main Out connector.

Measure the trise, tfall, and distortion at the High Voltage Channel A Main Out connector.

Repeat for arb channel 2 (if installed) and High Voltage Channel B Main Out.

Repeat for arb channel 3 (if installed) and High Voltage Channel C Main Out.

Repeat the test on arb channels 1, 2, and 3 (if installed) with the channel board amplitude set to 5 Vpk.

Repeat the test on arb channels 1, 2, and 3 (if installed) with the channel board amplitude set to 2.505 Vpk.

Rise/Fall Time: < 400 ns

Aberrations: 5% +100 mV

4.1.5.4 External Summing Amplitude and Rise Time Test

Purpose: To verify compliance of square wave distortion specifications.

Spec: Rise/Fall < 400 ns and < 5% +100 mVp-p aberrations.

Setup: Terminate all three High Voltage module outputs into 500 ohms.

Click on the High Voltage board In A box to connect the External In A input to the Ch 1 Summing Amplifier.

Apply an externally terminated (50 ohms) square wave of 200 kHz, 8 Vp-p, 2 ns , and rise time (trise) < 50 ns to the In A input connector.

Click on the Ch A output switch to route Channel 1 to High Voltage Channel A Main Out connector.

Measure the trise and tfall at the High Voltage Channel A Main Out connector.

Repeat for External In B input to the Ch 2 Summing Amplifier and High Voltage Channel B Main Out if installed.

Repeat for External In C input to the Ch 3 Summing Amplifier and High Voltage Channel C Main Out, if installed.

Rise/Fall Time: < 400 ns

Aberrations: < 5% +100 mV

4.1.5.5 Sine Total Harmonic Distortion

Purpose: To verify the distortion compliance of the High Voltage channels with waveform distortion specifications.

Spec: See below

Setup: Terminate all three High Voltage module outputs into 500 ohms.

On arb channel board 1, select Sine function and 15 Vp-p.

Click on the Ch 1 Channel Value box and set the High Voltage output amplitude to 80 Vp-p.

Click on the Ch 1 arb channel switch to route Channel 1 to HV output A.

Click on the Ch A output switch to route Channel 1 to High Voltage Main Out connector.

Measure the waveform distortion at the High Voltage Channel A Main Out connector.

Repeat for arb channel 2 and High Voltage Channel B Main Out if installed.

Repeat for arb channel 3 and High Voltage Channel C Main Out if installed.

AMPL	Freq	Spec
80 Vp-p	1 kHz	No harmonic > –55 dBc
80 Vp-p	10 kHz	No harmonic > –45 dBc

4.2 ALIGNMENT PROCEDURE

4.2.1 Purpose

The purpose of this document is to define the procedures and equipment required to align the Model 295 and ensure that the instrument meets its specifications. The procedures should be carried out only by qualified personnel using the proper measurement equipment.

This document does not list the specification or internal acceptance limits. Before attempting this procedure, you should familiarize yourself with these limits. The document does, however, suggest alignment limits to be used as ***guidelines*** when adjusting certain parameters. These guidelines may have to be revised in the future if specifications change.

4.2.2 Equipment Required

The following list of test equipment is included for reference only. Substitution of any equipment is allowed as long as adequate measurement accuracy is maintained. Test equipment should always provide at least 5 times more measurement accuracy than the specification of the parameter being tested.

Only equipment that has been properly serviced and calibrated (traceable to NBS) according to the manufacturers' specifications may be used for calibration.

RF Voltmeter:	Boonton Model 9200B
Oscilloscope:	Tektronix Model 2465B
Universal Counter:	Hewlet Packard Model 5334B

4.2.3 Alignment Overview

The alignment of the Model 295 can be divided into 3 sections: manual adjustments, automatic internal calibration, and semiautomatic adjustments. The manual and semiautomatic adjustments are intended for alignment only during a full calibration cycle. The automatic internal calibration, or Autocal, may be invoked at any time for improved accuracy. This will allow you to correct critical parameters at the time and temperature of use.

The manual adjustments need to be performed prior to installation of the arb module cover. The remaining calibration can be performed with all covers installed. The Auto-cal may also be used to ensure functionality before installing arb module cover.

In each step of the calibration there is a description of the remote interface and front panel commands required to set up the instrument. Some of the remote interface commands require a numeric suffix indicating the addressed channel. These commands are indicated by an (n) suffix, where n is the channel index.

4.2.4 Chassis Alignment

4.2.4.1 Frequency Reference Oscillator Adjustment

The reference oscillator is located on the Processor board (1100-00-3497).

Step 1

Enable the reference output BNC by selecting internal reference.

Remote Commands:

SYST:REF:SOUR INT

Front Panel:

Select the Instrument screen.

Select the 10 MHz Reference screen.

Select Output, then DONE.

Step 2

Verify that the Reference Output frequency is 10 MHz ±1 Hz.

Step 3

If out of tolerance, turn Off the Model 295 and remove the top and bottom covers.

Step 3

Turn On the Model 295 and allow it to stabilize for 10 minutes.

Step 4

Remove the 4 screws securing front panel to instrument. Pull front panel assembly away from the instrument and being careful not to disconnect the ribbon cable near the top of the Processor board (J2). This will give access to the Reference Oscillator (U51).

Step 5

Remove the adjustment seal from the Reference Oscillator (U51) and adjust until the Reference Output frequency is 10 MHz ±1 Hz.

Step 6

Reattach adjustment seal, verify that the ribbon cable to J2 is firmly-connected, and then reattach front panel assembly to the instrument.

Step 7

Turn Off the Model 295 and reinstall the top and bottom covers on the instrument.

4.2.5. Arb Module Alignment

4.2.5.1 Square Wave Quality

The controls for this parameter are R179 and R197 located on the Arb Channel Board (1100-00-3522). To adjust these controls, the arb channel module must be installed in slot 1 of the Model 295 chassis with the module cover removed. With the Model 295 top cover in place, allow the unit to warm up at least 20 minutes.

Step 1

Configure the arb channel module as follows:

Function: Square

Frequency: 10 MHz

Amplitude: 5 Vpk

Remote Commands:

OUTP1 ON

SOUR1:FUNC HFSQ

SOUR1:FREQ 10E6

SOUR1:VOLT 5

Front Panel:

Select Channel screen.

Select Output field and turn on output.

Select Function field and select function SQUARE.

Select Ampl field and use keypad to program 5 Vpk.

Select Freq field and use keypad to program 10 MHz.

Step 2

Adjust R179 and R197 for ***minimum*** aberrations while maintaining acceptable rise/fall time. R179 will control mainly the positive portion of the waveform, and R197 will control mainly the negative portion. There will, however, be some interaction. The goal of these adjustments is a square wave with a smooth transition from the rising and falling edges to its final value. The typical arb channel module will produce rise/fall times <8.0 ns with aberrations < 200 mVp-p.

Step 3

Set amplitude to 7.5 Vpk and verify rise/fall times < 9 ns and aberrations < 300 mV. If out of tolerance, readjust R179 and R197 then verify performance at 5 Vpk to the acceptance test limits.

4.2.5.2 Internal Automatic Calibration

This step of the alignment uses the internal DC voltage measurement capability to bring the offset and amplitude parameters within specification limits. For a proper alignment, the arb module cover and all chassis covers should be installed. Allow the unit to warm up at least 20 minutes.

Step 1

Initiate the auto calibration sequence.

Remote Commands:

CAL(n)?

Front Panel:

Select the Instrument screen.

Select the Test/Cal menu entry.

Select the Auto-Cal menu entry.

Select the channels to be calibrated and click on DONE.

Step 2

Verify the unit returns a zero result indicating calibration was successful. Refer to the auto calibration description section for an explanation of the procedures and results of the auto calibration.

Remote Commands:

Remote query returns value of zero if auto calibration was successful. A nonzero result indicates an auto calibration failure.

Front Panel:

Dialog box will be displayed when autocalibration is complete. Box will display numeric result of calibration. A successful calibration will return 0. An unsuccessful calibration will return a hex number indicating the failure type.

4.2.5.3 Semiautomatic Adjustments

This step of the alignment uses external equipment to measure parameters beyond the capabilities of the internal measurement system. The results of the external measurements are then returned to the Model 295 and stored in nonvolatile calibration memory.

The Front Panel description for Square Wave Symmetry describes how to reach the appropriate screen. The remaining steps assume that the calibration steps are being performed sequentially and the screen is currently visible.

When using a scroll bar to adjust a parameter, the following rules apply. If using a mouse, simply click on the up or down arrow in the scroll bar. If using the keyboard, use the cursor keys to move the highlight to the scroll bar, then press the Select key. This will enable adjustment of the scroll bar with the up and down cursor keys. When adjustment is completed, press the Select key.

Square Wave Symmetry

Step 1

Configure the arb channel module as follows:

Function: Square

Frequency: 1 MHz

Amplitude: 5 Vpk

Remote Commands:

OUTP(n) ON

SOUR(n):FUNC HFSQ

SOUR(n):FREQ 1E6

SOUR(n):VOLT 5

Front Panel:

Select Channel Setup screen.

Select Output field and enable output On.

Select Instrument screen.

Select Test/Cal from the menu.

Select Manual Cal from the next menu.

Select desired channel with Chan entry box.

Select scroll bar under Square Symmetry field.

Step 2

Verify that the square wave symmetry is 50% ±0.2%.

Step 3

If out of tolerance, query the unit for its current square symmetry constant. The constant will be a decimal number between 0 and 4095.

Remote Commands:

CAL(n):DATA:SQRS?

Front Panel:

Constant is displayed in Square Symmetry field.

Step 4

Program a new constant and reverify symmetry. Iterate until symmetry is within 0.2% of 50%. A larger number results in an increase in the pulse width of the positive portion of the square wave.

Remote Commands:

CAL(n):DATA:SQRS (constant)

Front Panel:

Use cursor keys or mouse to adjust symmetry with the scroll bar.

Step 5

Store new constant.

Remote Commands:

CAL(n):DATA:STORE

Front Panel:

Click in the STORE CALIBRATION field.

NOTE *This step may be postponed until the entire semiautomatic calibration is completed.*

SCM Carrier Null

Step 1

Configure the arb channel module as follows:

Function:	Sine
Frequency:	1 MHz
Amplitude:	5 Vpk
Modulation Mode:	SCM

Remote Commands:

OUTP(n) ON

SOUR(n):FUNC SIN

SOUR(n):FREQ 1E6

SOUR(n):VOLT 5

SOUR(n):AM:MODE SCM

SOUR(n):AM:STATE ON

Front Panel:

Select scroll bar under SCM NULL field.

Step 2

Verify the peak-to-peak amplitude of output signal < 75 mVp-p.

Step 3

If out of tolerance, query the unit for its current SCM zero constant. The constant will be a decimal number between 0 and 4095. There will be a null point in the amplitude *vs* cal-constant curve. The goal of this calibration is to find the null point.

Remote Commands:

CAL(n):DATA:SCMZ?

Front Panel:

Constant is displayed in SCM Null field.

Step 4

Program a new constant and measure signal level. Iterate until amplitude is < 75 mVp-p.

Remote Commands:

CAL(n):DATA:SCMZ (constant)

Front Panel:

Use cursor keys or mouse to adjust amplitude with the scroll bar.

Step 5

Store new constant.

Remote Commands:

CAL(n):DATA:STORE

Front Panel:

Click in the STORE CALIBRATION field.

NOTE *This step may be postponed until the entire semiautomatic calibration is completed.*

Elliptic Filter Amplitude Flatness Correction

This calibration is intended to correct for the amplitude ripple of the elliptic filter used for standard sine waves. The basic procedure is to measure the amplitude error at five frequencies and send the appropriate correction constant to the Model 295. The Model 295 will use these constants to set up a correction *vs* frequency table in the nonvolatile calibration memory.

The correction table is broken into four frequency ranges. The ranges are DC to the frequency of index 1; frequency of index 1 to frequency of index 2; frequency of index 2 to frequency of index 3; frequency of index 3 to frequency of index 4; frequency of index 4 to frequency of index 5.

Calibration involves determining the corrections at the boundaries of these ranges. Each correction point is assigned an index number, a frequency, and a correction, with the following defaults:

Index	Frequency	Correction
0	DC	1.00
1	7 MHz	1.00
2	13 MHz	1.00
3	17 MHz	1.00
4	19 MHz	1.00
5	20 MHz	1.00

The default range boundaries or frequencies usually will not need to be changed. The corrections are what is determined from this procedure. If acceptable performance is not achieved, then one or more of the frequencies may need to be modified. If this is the case, set the index frequency in the nonconforming frequency band to the nearest amplitude maximum or minimum.

For example, suppose that after calibration it is determined that amplitudes in the 12 to 14 MHz frequency range do not meet specification. By measuring the amplitude *vs* frequency in that band it is determined that the maximum amplitude is at 12 MHz. Change the frequency of index 2 to 12 MHz.

On the MANUAL CALIBRATION screen there is a frequency field under Frequency Response. This field allows programming of the index frequency and also controls the output frequency of the channel during this procedure. If required, the search for the amplitude maximum or minimum should be done using this frequency control as the calibration constants are turned off.

Step 1

Configure arb channel module as follows:

Function: Sine

Frequency: 50 kHz

Amplitude: 5 Vpk

Remote Commands:

OUTP(n) ON

SOUR(n):FUNC SIN

SOUR(n):FREQ 5E4

SOUR(n):VOLT 5

Front Panel:

Select the Point under Frequency Response and enter 0.

Select Frequency field and enter 50E4.

Step 2

Measure the amplitude at 50 kHz and use as the reference amplitude.

Step 3

Measure the amplitude error at 7 MHz relative to 50 kHz. For best results this data point should use the default correction of 1.00 unless its error is > 2%. If error is > 2% send the appropriate correction to the Model 295.

Example: 7 MHz amplitude is 1.05 times higher than 50 kHz amplitude. Error is 0.05 (5%). Correction factor is 1/(1+ error) or 0.952.

Remote Commands:

SOUR(n):FREQ 7E6

CAL(n):DATA:AMPL:AFC 1,7E6, (correction factor)

Front Panel:

Select Point field and enter 1 in the box.

Select Gain field and enter the correction factor.

Step 4

Measure the amplitude error at 13 MHz relative to 50 kHz. Send the appropriate correction to the Model 295.

Remote Commands:

SOUR(n):FREQ 13E6

CAL(n):DATA:AMPL:AFC 2,13E6, (correction factor)

Front Panel:

Select Point field and enter 2 in the box.

Select Gain field and enter the correction factor.

Step 5

Measure the amplitude error at 17 MHz relative to 50 kHz. Send the appropriate correction to the Model 295.

Remote Commands:

SOUR(n):FREQ 17E6

CAL(n):DATA:AMPL:AFC 3,17E6, (correction factor)

Front Panel:

Select Point field and enter 3 in the box.

Select GAIN field and enter the correction factor.

Step 6

Measure the amplitude error at 19 MHz relative to 50 kHz. Send the appropriate correction to the Model 295.

Remote Commands:

SOUR(n):FREQ 19E6

CAL(n):DATA:AMPL:AFC 4.19E6, (correction factor)

Front Panel:

Select Point field and enter 4 in the box.

Select GAIN field and enter the correction factor.

Step 7

Measure the amplitude error at 20 MHz relative to 50 kHz. Send the appropriate correction to the Model 295.

Remote Commands:

SOUR(n):FREQ 20E6

CAL(n):DATA:AMPL:AFC 5.20E6, (correction factor)

Front Panel:

Select Point field and enter 5 in the box.

Select GAIN field and enter the correction factor.

Step 8

Store calibration constants. Turn calibration state On.

Remote Commands:

CAL(n):DATA:STORE

Front Panel:

Select STORE CALIBRATION field.

4.2.6 High Voltage Module Calibration

The following instructions assume the instrument was in the reset state at the beginning of calibration.

4.2.6.1 Offset Null

The controls for this parameter are R6, R23, and R35 located on the High Voltage Channel Board (1100-00-3673). To adjust these controls, the High Voltage Channel Module must be installed in slot 4 of the 295 chassis, on an extender card with its module cover removed. Allow the unit to warm up at least 20 minutes. Measure offset at the main output for each high voltage channel. On each channel board, create a user-defined waveform consisting of 5 points programmed to 0.

Step 1

Configure each channel board as follows:

Function: User defined

Amplitude: 7.5 Vpk

Sample Frequency: 1 kHz

Step 2

Configure each channel of the high voltage module as follows:

Amplitude: 80 Vp-p

Output: ON

Step 3

Adjust R6, R23, and R35 for ***minimum*** DC offset. R6 will control Output A, R23 will control Output B, and R35 will control Output C. The goal of these adjustments is minimum DC offset, < 10 mV.

Step 4

Configure each channel of the high voltage module as follows:

Amplitude: 20 Vp-p

Output: ON

Step 5

Adjust R6, R23, and R35 for ***minimum*** DC offset. R6 will control Output A, R23 will control Output B, and R35 will control Output C. The goal of these adjustments is minimum DC offset, < 10 mV.

Step 6

Repeat steps 2 through 5 until both DC Offsets are within specifications.

4.2.6.2 Amplitude Calibration

The controls for this parameter are R2, R19, and R31 located on the High Voltage Channel Board (1100-00-3673). To adjust these controls, the High Voltage Channel Module must be installed in slot 4 of the 295 chassis, on an extender card with its module cover removed. Allow the unit to warm up at least 20 minutes. Measure amplitude at the main outputs. The output must be terminated into 500Ω.

Step 1

Configure channel board as follows:

Function: Sine

Frequency: 1 kHz

Amplitude: 5 Vpk

Step 2

Configure each channel of the high voltage module as follows:

Amplitude: 80 Vp-p

Output: ON

Step 3

Adjust R2, R19, and R31 for 80 Vp-p or 28.28 Vrms ±28 mVrms. R2 will control Output A, R19 will control Output B, and R31 will control Output C. The goal of these adjustments is to improve accuracy.

Step 4

Repeat steps 2 and 3 for the amplitude set to 40 Vp-p and then again for 20 Vp-p. In all cases the offset should never exceed ±350 mV. Adjust R6, R23, and R35 such that all points are within spec.

4.2.6.3 Auto Calibration Response Description

This section outlines the internal procedures and the response codes for Auto-cal. There are two levels of auto calibration responses. One is system level, in response to the *CAL? query. This is available only through the remote interface. The other is channel specific in response to the remote query CAL(n)? and the front panel interface auto calibration.

*CAL?

According to IEEE Std. 488.2-1987 section 10.38, the Calibration query causes an internal self calibration to be performed and a response to be placed in the Output Queue. The response to the *CAL? query is an ASCII string representing an integer value. The value of 0 is returned if the auto calibration passed, and a nonzero value in the range of 32767 to –32768 is returned if the auto calibration failed. The interpretation of the value returned in the event of a failed self calibration is user defined.

Since the Model 295 is a multichannel instrument, the response to the *CAL? query is a composite of the responses to the self calibrations executed on each installed channel.

When the *CAL? query is received each installed channel is instructed to perform its auto calibration. If the response from a channel indicates the auto calibration passed, its status bit is set to 0. If a failure is indicated its status bit is set to 1. A status bit representing a channel that is not installed will always be returned set to 0. The status of the auto calibration performed on the CPU card is indicated by bit 0.

CALibrate<n>[:ALL]? Front Panel Auto Calibration

The CALibrate<n>[:ALL]? query allows the channels within the Model 295 to be queried individually. This allows a detailed error code to be returned indicating the nature of a failure. The value of a 16-bit Self Calibration Status Word is returned in response to the remote calibration query or displayed in a dialog box after a front panel initiated auto calibration. The format of the Self Calibration Status Word is shown below:

The Self Calibration Status Word is split into two fields, one occupying the lower eight bits and the other occupying the upper eight bits.

The Calibration Number field contains the number of the first subcalibration in which a failure was detected. Subcalibration numbers range from 1 to 255. Subcalibrations are performed in the same sequence as they are numbered.

The Error Code field contains a bit weighted code that is unique to the subcalibration. The usage of bits 0 and 1 are common to all subcalibrations involving voltage measurements and have the following meaning:

Error Code Bit	Meaning
0	Voltage not settled after 10 measurements.
1	Voltage over range.

For the interpretation of the other bits in this field refer to the paragraph describing the subcalibration.

If no failures were detected during the auto calibration, then both the Calibration Number and Error Code fields will be set to zero.

The auto calibration saves the state of the instrument prior to starting and restores it after the calibration is complete. While performing the auto calibration the output relays remain open so as not to disturb any external devices.

The number of each of the subcalibrations and their Error Code formats are described below.

Before beginning any calibrations, Static Control Registers 0, 1 and 2 are set up with the following configuration:

Output:	Off
Filter:	Off
Sync Marker:	Off
Sumbus Output:	Off
Master Clock Output:	Off
Output Attenuator:	/1 range
Preamplifier source:	From Waveform DAC

The internal clock frequency is set to 50 MHz, and the AGS4804 is set up to select the first point in Trace Memory.

The scope of each of the subcalibrations and their Error Code formats are described in the following paragraphs.

Calibration 1 Trace Memory/BERR

If the Trace Memory test that was performed at power on indicates a failure or a bus error was generated when trying a access the arb channel module, then the self test is aborted and the Test Number is set to 1. Since so much of the rest of the self test is dependent on the proper functioning of the Trace Memory, it is pointless to continue until it has been repaired. For more information on the cause of the Trace Memory failure, refer to the documentation for the Trace Memory test.

Error Code Bit	Meaning
0	This bit may be set but it has no meaning
1	Trace Memory power on test failed
2	Bus error on access to hardware

Calibration 2 AMZERO

This calibration finds the AMZERO DAC voltage such that the output voltage does not change while varying the Amplitude Control DAC over its full range while the output of the Waveform DAC is at mid-range.

First the PAZERO DAC is set to a point where the voltage measured at the PREAMPHI test point is 0 when the Amplitude Control DAC and Waveform DAC are set up for an output amplitude of 0.

Next the AMZERO DAC is set to mid-range. The voltage at the PWRAMPLO test point is measured with the Amplitude Control DAC set to its minimum and maximum values, and the difference between the two measurements is taken. The AMZERO DAC is adjusted until this difference is less than 1 mV.

If any portion of this calibration fails, the calibration number is set to 2.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.
2	AMZERO DAC value not converging.

Calibration 3 PAZERO

This calibration sets the output of the preamplifier to 0 volts when the amplitude is programmed to 0 volts by adjusting the PAZERO DAC voltage.

The PAZERO DAC is set to mid-range and then adjusted until the voltage measured at the PREAMPTP test point is within 1 mV of 0 volts.

If any portion of this calibration fails, the calibration number is set to 3.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.
2	PAZERO DAC value not converging.

Calibration 4 Offset Gain

This calibration calculates the gain of the offset control DACs.

The Amplitude Control DAC and the Positive and Negative Offset Control DACs are programmed for 0 volts output.

The voltage at the PWRAMPHI test point is measured with the positive offset control DAC programmed to 1/8 and 7/8 of its range, and the difference between the two measurements is taken. The gain is stored as the ratio between the DAC control value and the output voltage.

GAIN = (DAChi - DAClo)/(Vhi - Vlo)

The voltage at the PWRAMPHI test point is measured with the negative offset control DAC programmed to 1/8 and 7/8 of its range, and the difference between the two measurements is taken. The gain is calculated in the same manner as for the positive offset control DAC.

If this calibration fails, the calibration number is set to 4.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.

Calibration 5 Offset.

This calibration corrects for the offset of the offset control DACs and the output amplifier by adjusting the OFFSFIN DAC.

The OFFSFIN DAC is set to mid-range, and the output offset voltage is programmed to 0.5 volts. The OFFSFIN DAC is adjusted until the output offset voltage measured at the PWRAMPLO test point is within 1 mV of 0.5 volts. The OFFSFIN DAC value is saved to be used to correct positive output offset voltages.

The OFFSFIN DAC is set to mid-range, and the output offset voltage is programmed to –0.5 volts. The OFFSFIN DAC is adjusted until the output offset voltage measured at the PWRAMPLO test point is within 1 mV of -0.5 volts. The OFFSFIN DAC value is saved to be used to correct for negative output offset voltages.

If any portion of this calibration fails, the calibration number is set to 5.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.
2	Positive offset correction not converging.
3	Negative offset correction not converging.

Calibration 6 Amplitude Gain

This calibration calculates the gain of the Amplitude Control DAC for the output of the Waveform DAC.

The Positive and Negative Offset Control DACs are programmed for 0 volts output.

The positive and negative peak amplitude voltages at the PWRAMPHI test point are measured with the Amplitude Control DAC programmed to 1/8 and 7/8 of its range. The difference between the peak-to-peak amplitude voltage in the two ranges is calculated. The gain is stored as the ratio between the _ DAC control value and the _ peak-to-peak output voltage.

GAIN = (DAChi - DAClo)/(Vpphi - Vpplo)

If this calibration fails, the calibration number is set to 6.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.

Calibration 7 Amplitude Offset

This calibration corrects for the offset of the Amplitude Control circuits by adjusting the AMPLZERO DAC.

The AMPLZERO DAC is set to mid-range, and the output amplitude voltage is programmed to 0.5 volts. The AMPLZERO DAC is adjusted until the peak-to-peak output amplitude voltage measured at the PWRAMPLO test point is within 1 mV of 0.5 volts. The AMPLZERO DAC value is saved to be used to correct output amplitude voltages.

If any portion of this calibration fails, the calibration number is set to 7.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.
2	Amplitude offset correction value not converging.

Calibration 8 High Frequency Square Wave Gain

This calibration calculates the gain of the Amplitude Control DAC for the output of the square wave generator. It follows exactly the same procedure as the Amplitude Gain calculation for the output of the Waveform DAC. The gain correction factor calculated in this calibration is used only when the source of the input signal to the preamplifier is from the square wave generator.

If any portion of this calibration fails, the calibration number is set to 8.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.

Calibration 9 High Frequency Square Wave Offset

This calibration corrects for the offset of the square wave generator at the preamplifier input. The offset voltage at the PWRAMPHI test point is measured with the Square Wave generator chosen as the preamplifier input. The AMZERO DAC is varied until this offset voltage is < 1 mV. The offset correction factor calculated in this calibration is used only when the source of the input signal to the preamplifier is from the square wave generator.

If any portion of this calibration fails, the calibration number is set to 8.

Error Code Bit	Meaning
0	Voltage measurement not settled after 10 measurements.
1	Voltage measurement over range.
2	AMZERO DAC value not converging.

5.1 DRAWINGS

The following assembly drawings, schematics, and parts lists are arranged in order shown below.

5.1.1 Assembly Drawing

All of the mechanical assembly drawings are show in this section. These drawings contain enough detail and clarity to assist the repair technician in the disassembly and reassembly of the model 295 The parts lists for each assembly drawing immediately follow that drawing.

5.1.2. Schematics

All of the schematics for the model 295 are shown in this section. Schematic drawings containing a proprietary message may not be copied for resale or use in any other publication nor for any use other than the repair and maintenance of the instrument associated with this manual.

5.1.3 Parts Lists

The parts lists for each individual board or assembly are shown immediately following that board or assembly. The parts lists contain Wavetek and manufacturers parts information. All manufacturers are listed by a Wavetek code designation.

5.2 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permits. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

5.3 ORDERING PARTS

When ordering spare parts, please specify the part number, circuit reference, board, serial number of the unit, and, if applicable, the function performed.

The number etched into a printed circuit board is the board part number. The assembly (Printed circuit board and components on the board) part number is stamped on the board.

ASSEMBLY DRAWING	DRAWING NUMBER
Top Assembly Drawing	1001-00-0675
Instrument Parts List	1000-00-0675-06
Instrument Schematic	1004-00-0675
Arb Module Assembly Drawing	1101-00-3561
Arb Module Assembly Parts List	1100-00-3561-02
Channel Board Assembly Drawing	1101-00-3679
Channel Board Parts List	1100-00-3679-01
Channel Board Schematic	1104-00-3679
Arb Engine Board Assembly Drawing	1101-00-3674
Arb Engine Board Parts List	1100-00-3674-01
Arb Engine Board Schematic	1104-00-3674
Arb Processor Board Assembly Drawing	1101-00-3497
Arb Processor Board Assembly Parts List	1100-00-3497-04
Arb Processor Board Assembly Schematic	1104-00-3497
Backplane Board Assembly Drawing	1101-00-3514
Backplane Board Parts List	1100-00-3514-01
Backplane Board Schematic	1104-00-3514
Front Panel Assembly Drawing	1101-00-3533
Front Panel Assembly Parts List	1100-00-3533-02
Keypad Board Assembly Drawing	1201-00-3473
Keypad Board Assembly Parts List	1200-00-3473-01
Keypad Board Assembly Schematic	1204-00-3473
Chassis Gnd Wire Assembly Drawing	1201-00-3623
Chassis Gnd Wire Assembly Parts List	1200-00-3623
System BNC Cable Kit Assembly Drawing	1101-00-3560
System BNC Cable Kit Assembly Parts List	1100-00-3560-01
Power Supply Cable Assembly Drawing	1201-00-3525
Power Supply Cable Assembly Parts List	1200-00-3525-01
AC Switching Cable Assembly Drawing	1201-00-3678
AC Switching Cable Assembly Parts List	1200-00-3678-01
GPIB Cable Assembly Drawing	1201-00-3527
GPIB Cable Assembly Parts List	1200-00-3527-01
Fan Assembly Drawing	1201-00-3558
Fan Assembly Parts List	1200-00-3558-01
Rear Panel Assembly Drawing	1101-00-3441
Rear Panel Assembly Parts List	1100-00-3441
Rack Slide Kit Assembly Drawing	1101-00-3659
Rack Slide Kit Assembly Parts List	1100-00-3659-01

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
49	WASHER SPLIT LOCK #6,ZINC	0215-00059	AROW	0215-00059	14
REF	A/D,MODEL 295	1001-00-0675	WVTK	1001-00-0675	1
REF	ATS MODEL 295	1002-00-0675	WVTK	1002-00-0675	1
REF	INSTRUMENT SCHEMATIC 295	1004-00-0675	WVTK	1004-00-0675	1
REF	OPERATORS MANUAL 295	1006-00-0675-01	WVTK	1006-00-0675-01	1
REF	MAINTENANCE MANUAL 295	1006-00-0675-02	WVTK	1006-00-0675-02	1
REF	CALIBRATION PROCEDURE 295	1008-00-0675	WVTK	1008-00-0675	1
16	ASSY PCA, PROCESSOR BD MODEL 295	1100-00-3497-04	WVTK	1100-00-3497-04	1
13	BACKPLANE MODEL 295	1100-00-3514-01	WVTK	1100-00-3514-01	1
17	FRONT PANEL MODEL 295	1100-00-3533-02	WVTK	1100-00-3533-02	1
29	KIT,CABLE,SYSTEM BNC	1100-00-3560-01	WVTK	1100-00-3560-01	1
42	ARB MODULE ASSY MODEL 295	1100-00-3561-02	WVTK	1100-00-3561-02	1
50	ASSY,BLANK MODULE FACEPLATE	1100-00-3671-01	WVTK	1100-00-3671-01	3
19	ASSY, CABLE, POWER SUPPLY	1200-00-3525-01	WVTK	1200-00-3525-01	1
5	ASSY, CABLE, GPIB	1200-00-3527-01	WVTK	1200-00-3527-01	1
32	ASSY,CABLE,A.C.SWITCHING	1200-00-3678-01	WVTK	1200-00-3678-01	1
REF	A/D, ASSY, FAN	1201-00-3558	WVTK	1201-00-3558	1
7	JACK SCREW	859-0530	WVTK	1400-01-0530	2
3	POWER ROD	21-6201	WVTK	1400-01-6201	1
22	LABEL, WARNING: HAZARDOUS VOLTAGES	650-0760	WVTK	1400-02-0760	1
43	UNIT COVER-295	1400-02-5232	WVTK	1400-02-5232	1
41	SIDE PANEL-295	1400-02-5233	WVTK	1400-02-5233	2
NONE	LABEL, MODEL,P/N,SERIAL, 1.20X.50	1400-02-5235	WVTK	1400-02-5235	2
26	SPACER, FAN	1400-02-5242	WVTK	1400-02-5242	1
46	BOTTOM COVER	1400-02-5247	WVTK	1400-02-5247	1
36	SHIELD, BOTTOM, CHASSIS	1400-02-5253	WVTK	1400-02-5253	1
20	SHIELD, TOP, CHASSIS	1400-02-5254	WVTK	1400-02-5254	1
30	PANEL, REAR DRESS	1400-02-5260	WVTK	1400-02-5260	1
10	CHASSIS WELDMENT- EMC SHIELDING	1400-02-5270	WVTK	1400-02-5270	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
28	MOUNTING,PRESSURE SENSITIVE SOFT FINGERS	187P32-16.00-02	TECH	1600-03-0026	8
31	MOUNTING,PRESSURE SENSITIVE SOFT FINGERS	500P110-18.00-02	TECH	1600-03-0027	6
3	CONN,CONTACT,CRIMP	60618-1	AMP	2100-02-0063	2
2	CONN,HOUSING,2 POS,PLUG	1-480319-0	AMP	2100-02-0064	1
1	FAN,24V,3.62 FRM,45CFM,TUBE-AXIAL TYPE	M33423-16	NIDEC	2600-00-0016	1
1	TY-WRAP	TY-523M	TB	2800-00-0006	1
56	CLAMP,CABLE	E-4	RICH	2800-00-0022	1
11	FLAT CABLE CLIP	FANY-812-9	WEKSR	2800-00-0027	2
2	MNTG CLIP,CABLE TIE	SNF-2	WKESR	2800-00-0031	1
47	FOOT	10603-026	SCHRF	2800-08-0020	2
45	FOOT WITH TIP-UP	10603-025	SCHRF	2800-08-0021	2
4	CLIP,MOUNTING,FAN, 6-32	31720	NIDEC	2800-12-0063	4
34	NUT,FLEXLOC,6-32,Z	6-32 NUT F.L.	CMRCL	2800-15-6100	1
9	NUT,HEX,6-32 R/P,Z	6-32 R/P HEX NUT	CMRCL	2800-16-6100	6
54	SCREW,4-40X3/8,TRS HD,Z	4-40 X 3/8 TRS	CMRCL	2800-20-4106	4
52	SCREW,PHILIP,TRUSSHEAD,6-32X3/8" ZINC PLATING	6C37TM	WFAST	2800-21-6106	4
6	SCREW,JACK,KIT INCLUDES: QTY 2 PLUS WASHERS&NUTS	3341-1S	3M	2800-23-0037	2
21	SCREW,4-40X3/16,PHP,NYLOK PATCH	4-40 X 3/16	CMRCL	2800-23-4103	12
14	WASHER, FLAT, #6 BIN 495	#6FLAT WASHER	CMRCL	2800-26-6001	19
48	SCREW,6-32X1/2 PHP,Z	6-32 X 1/2	CMRCL	2800-38-6108	4
18	SCREW,6-32X3/4 PHP,Z 6-32 X 3/4	6-32 X 3/4 PAN	CMRCL	2800-38-6112	8
35	SCREW,6-32X5/8",PHP,Z ,NYLOCK PATCH	6C62PXXZ	CMRCL	2800-59-0010	2
15	SCREW,PH,6-32 X 5/16,PHLPS,NYLOK,SS	2800-59-6105	CMRCL	2800-59-6105	24
55	RUBBER SEAL	447	ACCUR	3000-00-0005	.3
NONE	MOUSE,SERIAL	M-MD14-DB9F	LGTCH	3000-00-0215	1
25	PWR SUPPLY,SWITCHING,6 OUTPUT +-5.2/12/24 V (EMC)	4000-01-0001	WVTK	4000-01-0001	1
NONE	PWR CORD, SHIELDED	6001-80-0009	WVTK	6001-80-0009	1

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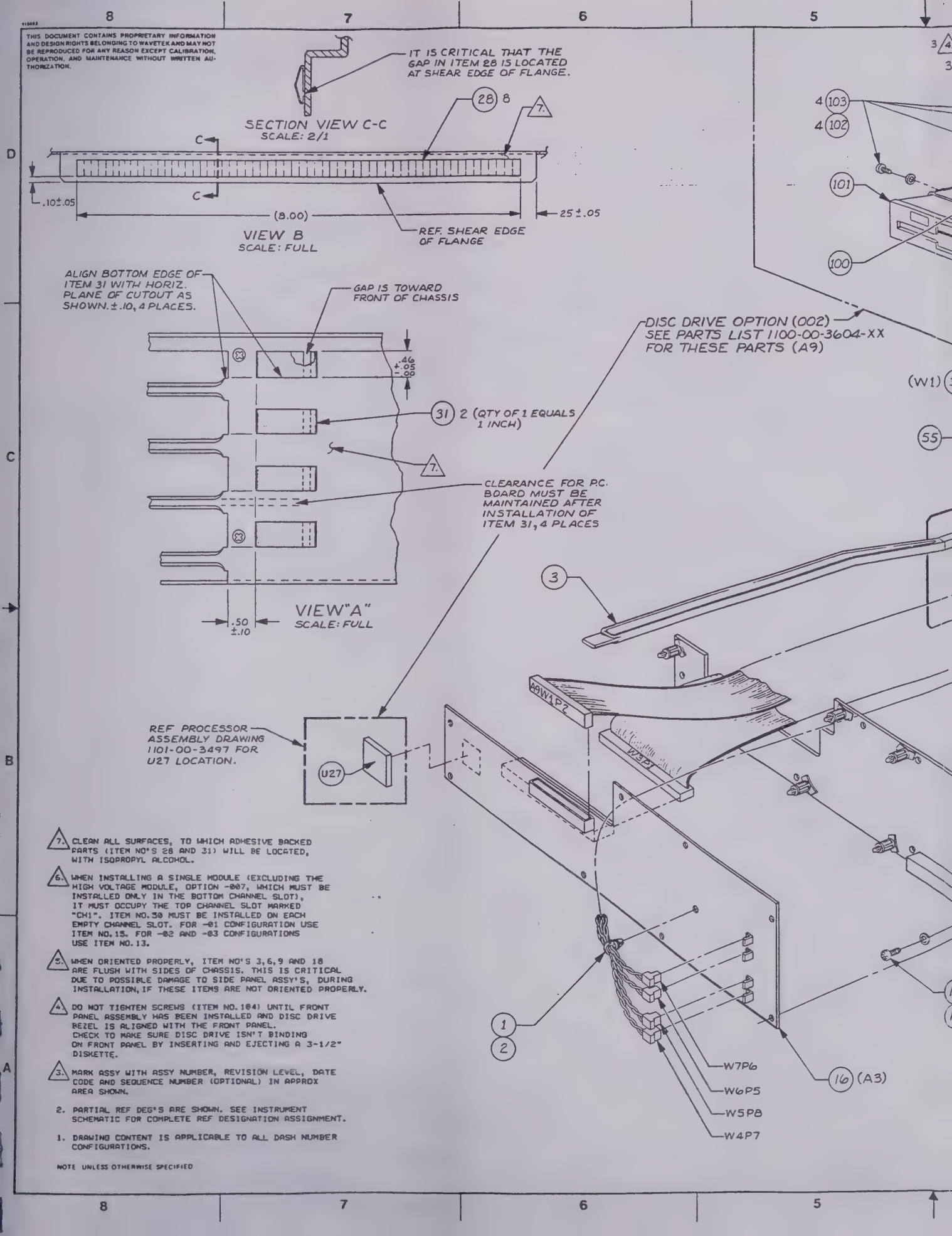


7. CLEAN ALL SURFACES, TO WHICH ADHESIVE BACKED PARTS (ITEM NO'S 28 AND 31) WILL BE LOCATED, WITH ISOPROPYL ALCOHOL.

6. WHEN INSTALLING A SINGLE MODULE (EXCLUDING THE HIGH VOLTAGE MODULE, OPTION -007, WHICH MUST BE INSTALLED ONLY IN THE BOTTOM CHANNEL SLOT), IT MUST OCCUPY THE TOP CHANNEL SLOT MARKED "CH1". ITEM NO.30 MUST BE INSTALLED ON EACH EMPTY CHANNEL SLOT. FOR -01 CONFIGURATION USE ITEM NO.15. FOR -02 AND -03 CONFIGURATIONS USE ITEM NO.13.

5. WHEN ORIENTED PROPERLY, ITEM NO'S 3, 6, 9 AND 18 ARE FLUSH WITH SIDES OF CHASSIS. THIS IS CRITICAL DUE TO POSSIBLE DAMAGE TO SIDE PANEL ASSY'S, DURING INSTALLATION, IF THESE ITEMS ARE NOT ORIENTED PROPERLY.

4. DO NOT TIGHTEN SCREWS (ITEM NO.104) UNTIL FRONT PANEL ASSEMBLY HAS BEEN INSTALLED AND DISC DRIVE BEZEL IS ALIGNED WITH THE FRONT PANEL. CHECK TO MAKE SURE DISC DRIVE ISN'T BINDING ON FRONT PANEL BY INSERTING AND EJECTING A 3-1/2" DISKETTE.

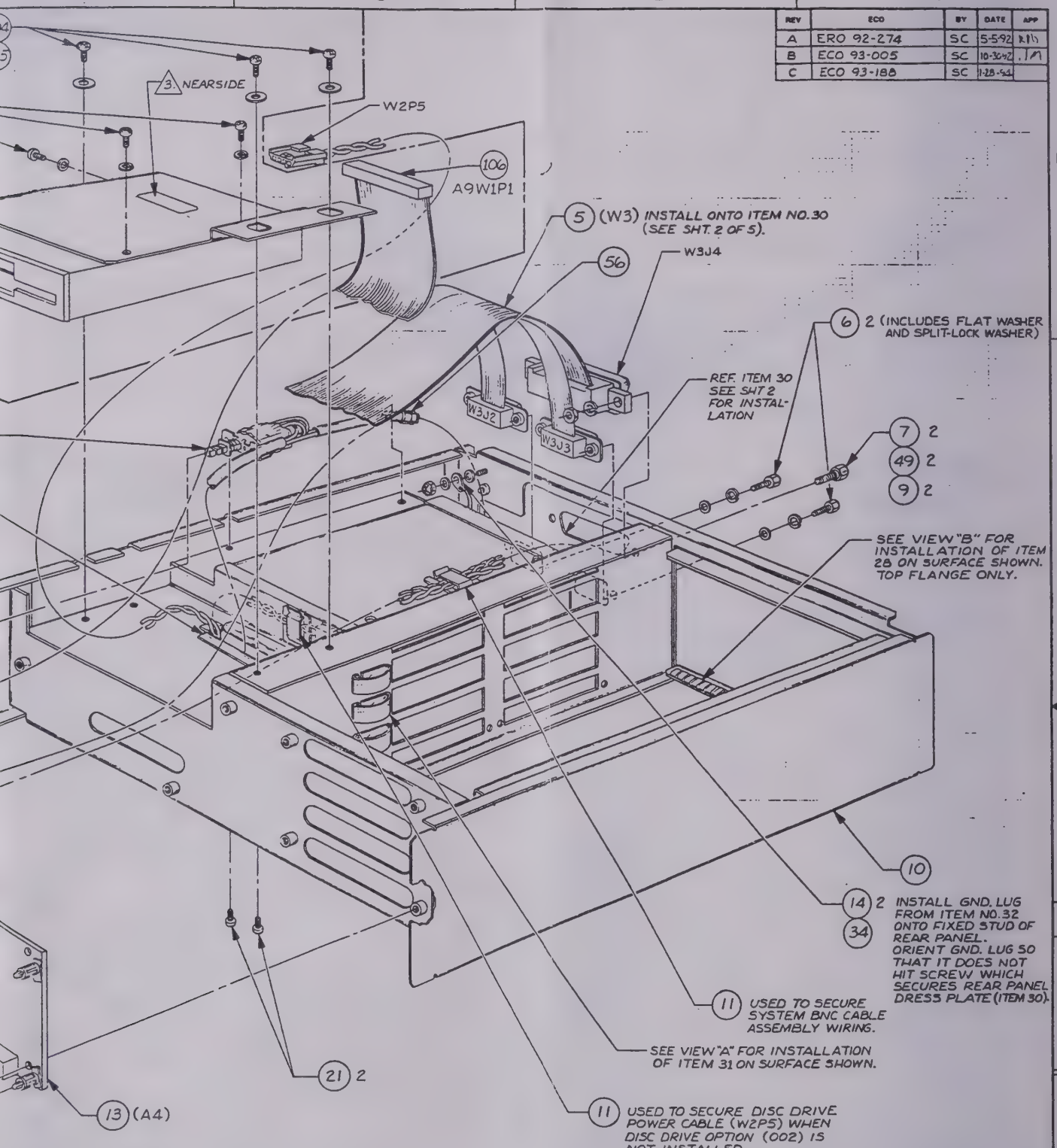
3. MARK ASSY WITH ASSY NUMBER, REVISION LEVEL, DATE CODE AND SEQUENCE NUMBER (OPTIONAL) IN APPROX AREA SHOWN.

2. PARTIAL REF DES'S ARE SHOWN. SEE INSTRUMENT SCHEMATIC FOR COMPLETE REF DESIGNATION ASSIGNMENT.

1. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-274	SC	5-5-92	
B	ECO 93-005	SC	10-30-92	
C	ECO 93-188	SC	1-28-93	


3. NEARSIDE
W2P5
106
A9W1P1
5 (W3) INSTALL ONTO ITEM NO. 30 (SEE SHT. 2 OF 5).
56
W3J4
6 2 (INCLUDES FLAT WASHER AND SPLIT-LOCK WASHER)
REF. ITEM 30 SEE SHT 2 FOR INSTALLATION
W3J2
W3J3
7 2
49 2
9 2
SEE VIEW "B" FOR INSTALLATION OF ITEM 28 ON SURFACE SHOWN. TOP FLANGE ONLY.
10
14 2
34
INSTALL GND. LUG FROM ITEM NO. 32 ONTO FIXED STUD OF REAR PANEL. ORIENT GND. LUG SO THAT IT DOES NOT HIT SCREW WHICH SECURES REAR PANEL DRESS PLATE (ITEM 30).
11 USED TO SECURE SYSTEM BNC CABLE ASSEMBLY WIRING.
SEE VIEW "A" FOR INSTALLATION OF ITEM 31 ON SURFACE SHOWN.
21 2
13 (A4)
11 USED TO SECURE DISC DRIVE POWER CABLE (W2P5) WHEN DISC DRIVE OPTION (002) IS NOT INSTALLED.

SEE SEPARATE PARTS LIST.

NOTE: DRAWING CONTENT SHOWN ON THIS SHEET IS APPLICABLE TO -04 AND ON CONFIGURATIONS

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 2-18-92
MATERIAL	CHECKED N. E. Mullen	11/9/92
	PROJ. ENGR. RJG	
	RELEASE APPROV. RJG	1/1/:
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE. FRACTIONS DECIMALS ANGLES	
DO NOT SCALE DRAWING	XX = XXX = =	

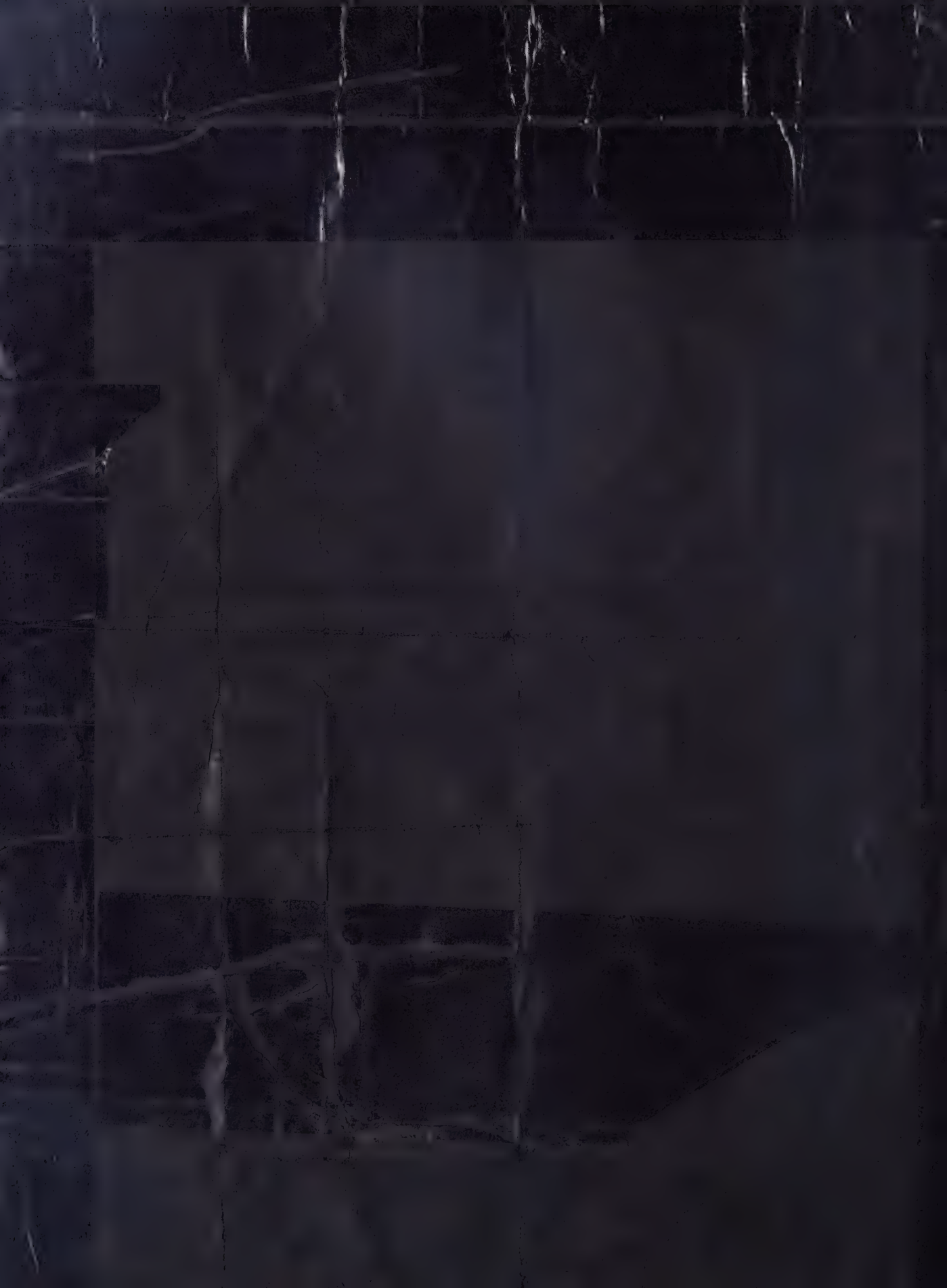
WAVETEK SAN DIEGO, CALIFORNIA

TITLE: ASSEMBLY DRAWING INSTRUMENT

SIZE	FSCM NO.	DWG. NO.	REV
D	23338	1001-00-0675	C

SCALE NONE | MODEL 295 | SHEET 1 OF 5

1001-00-0675



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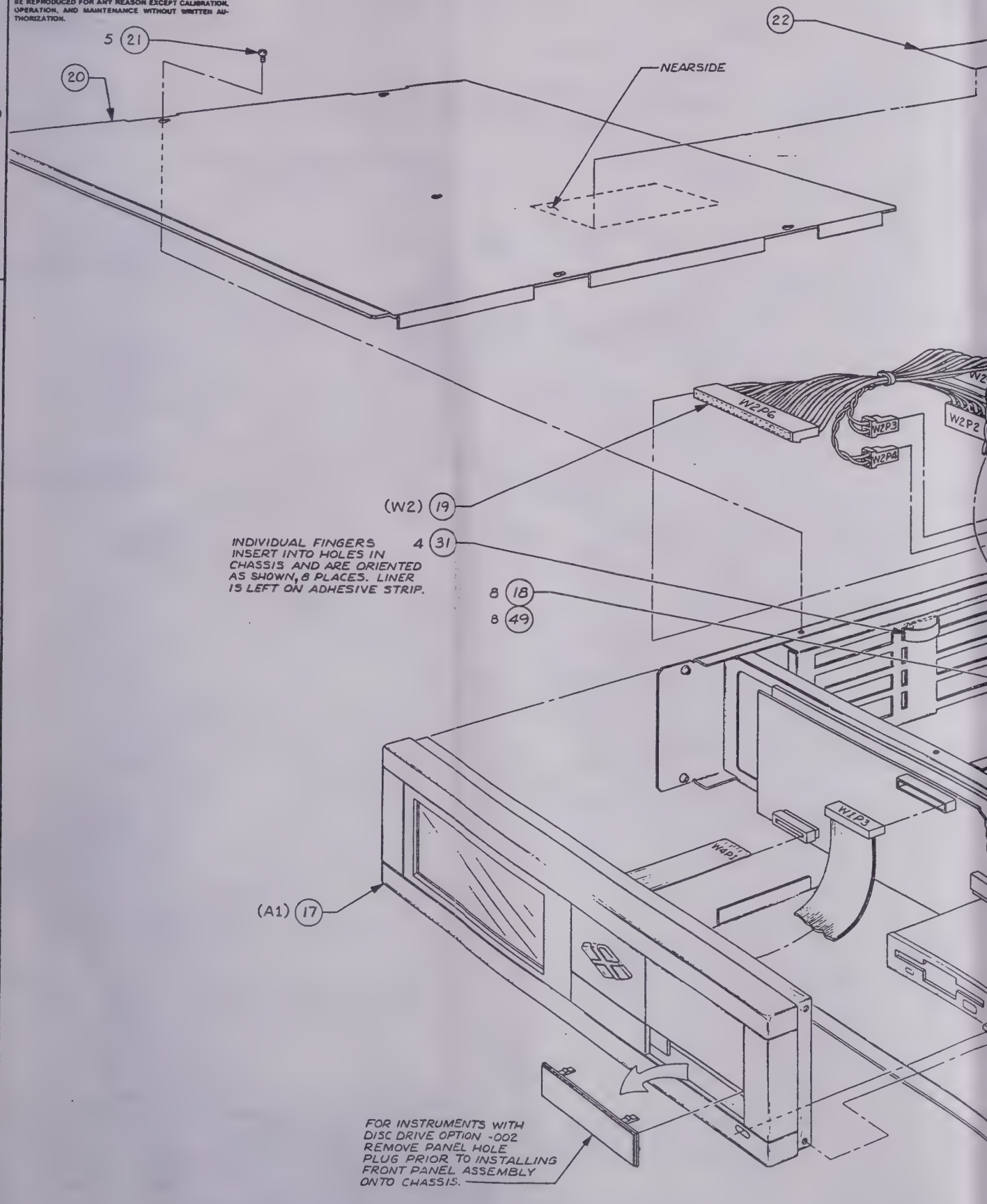
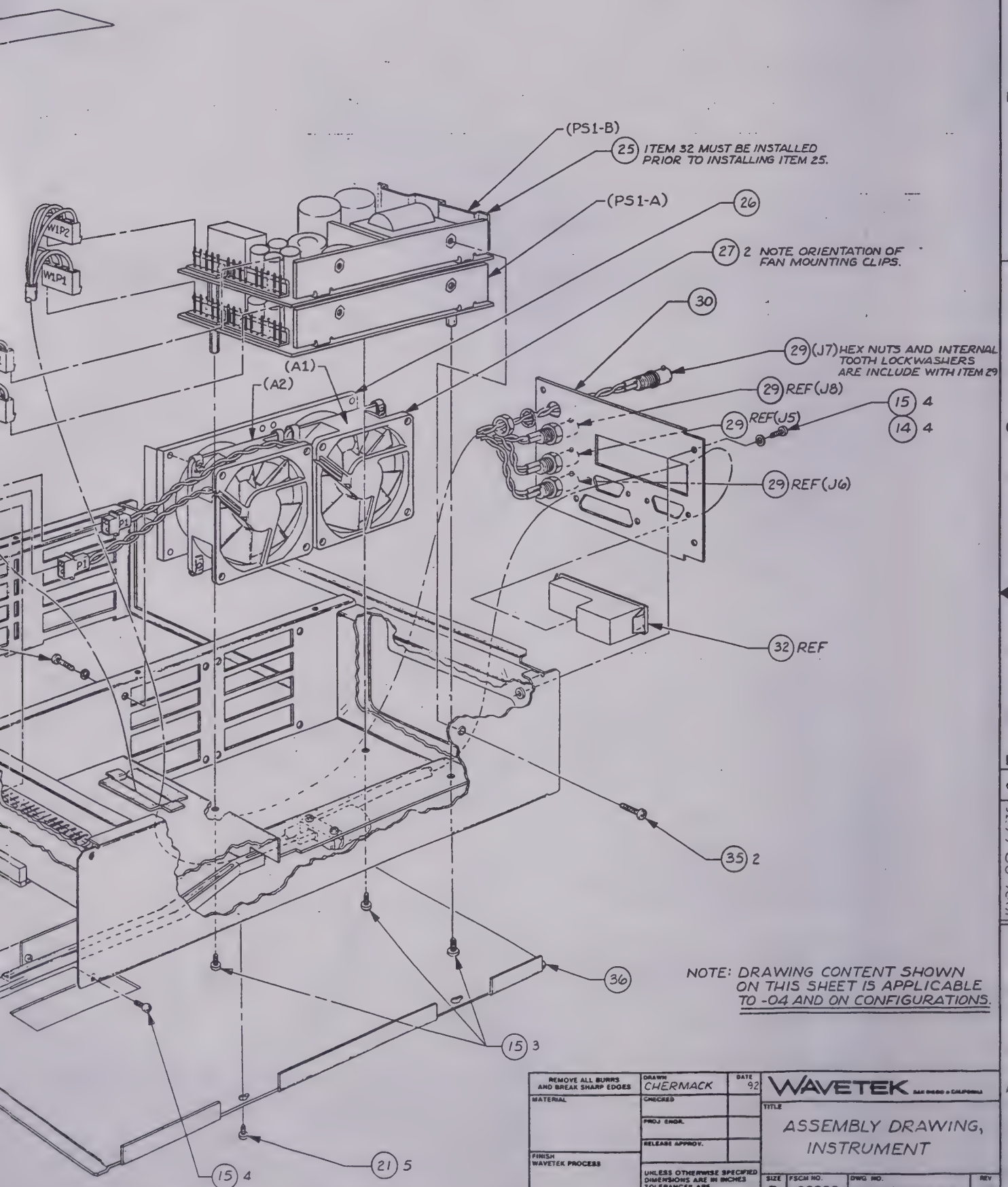


NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP



NOTE: DRAWING CONTENT SHOWN ON THIS SHEET IS APPLICABLE TO -04 AND ON CONFIGURATIONS.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: ASSEMBLY DRAWING, INSTRUMENT
	PROJ. ENGR.		
	RELEASE APPROV.		
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE. FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± ±		SIZE D · FSCM NO. 23338 · DWG. NO. 1001-00-0675 · REV C
DO NOT SCALE DRAWING			SCALE NONE · MODEL 295 · SHEET 2 OF 5

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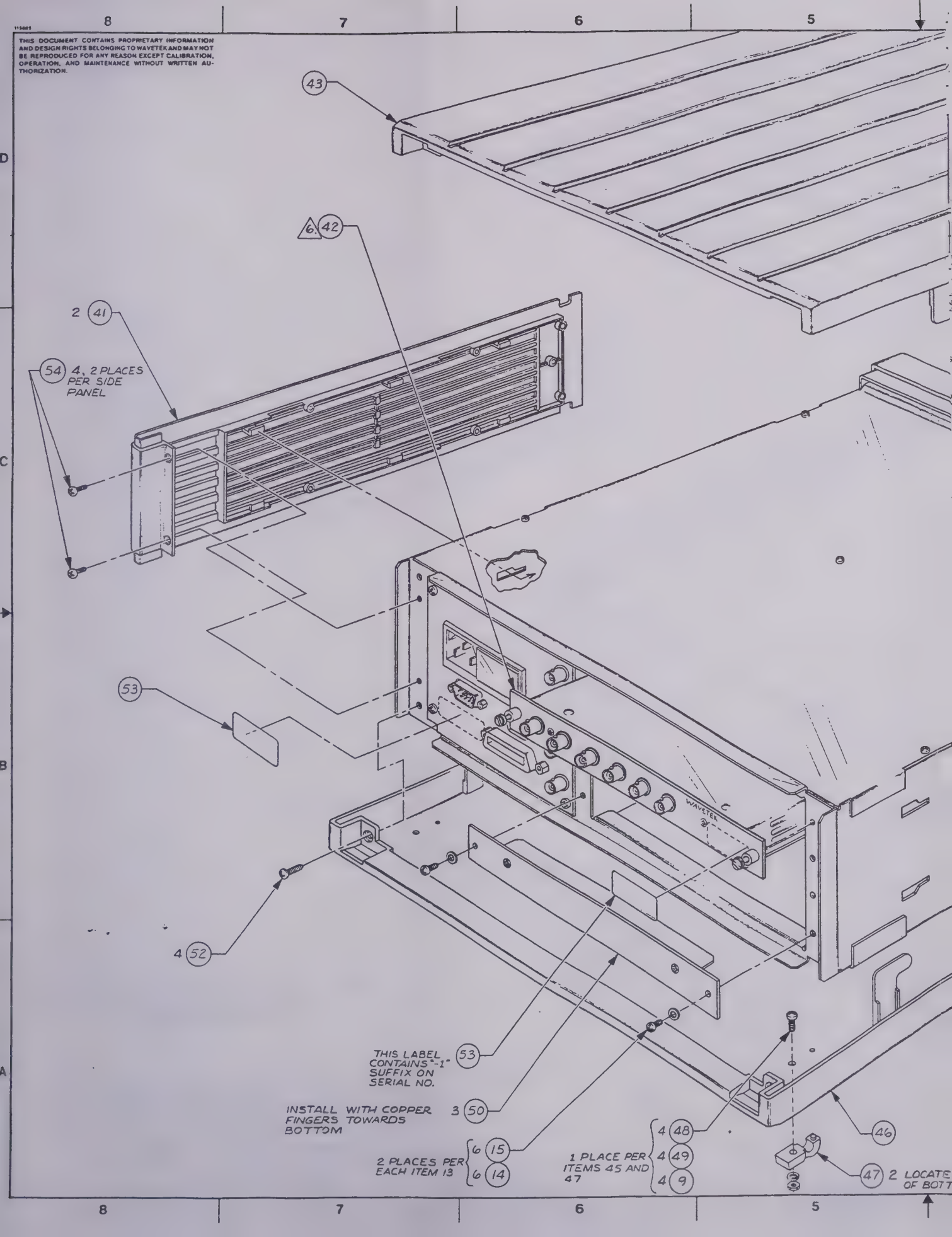
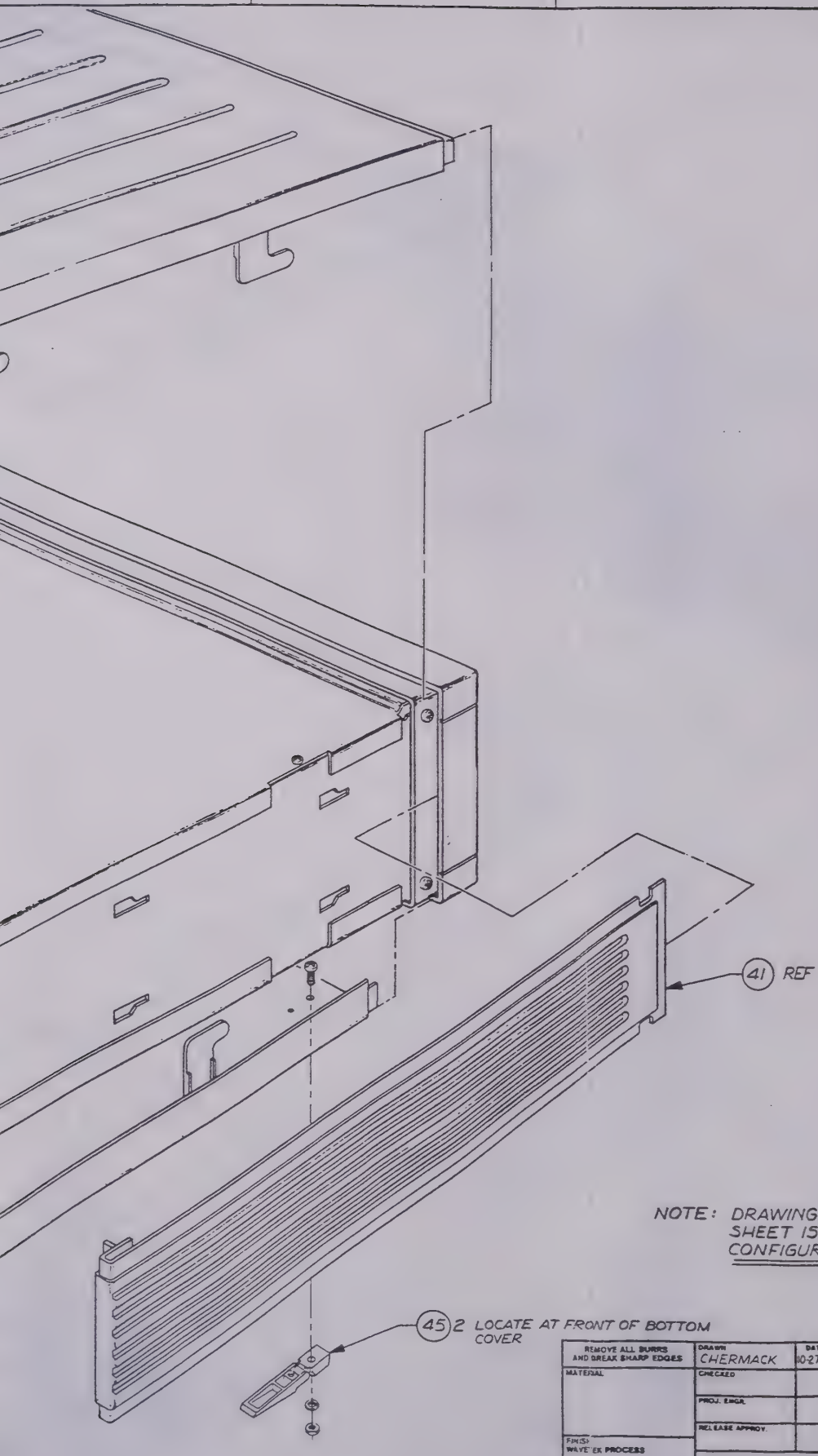


REV	ECO	BY	DATE	APP

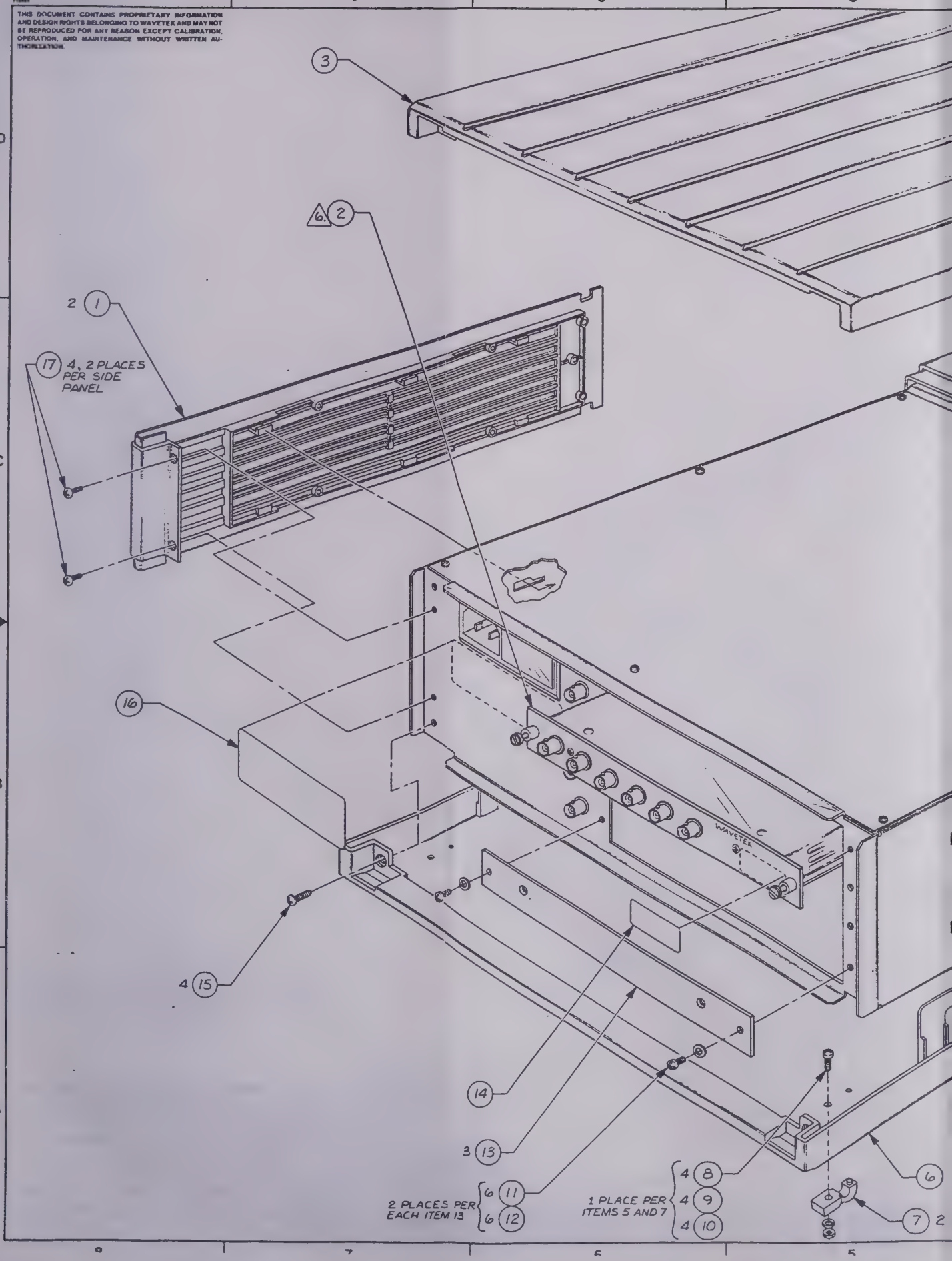


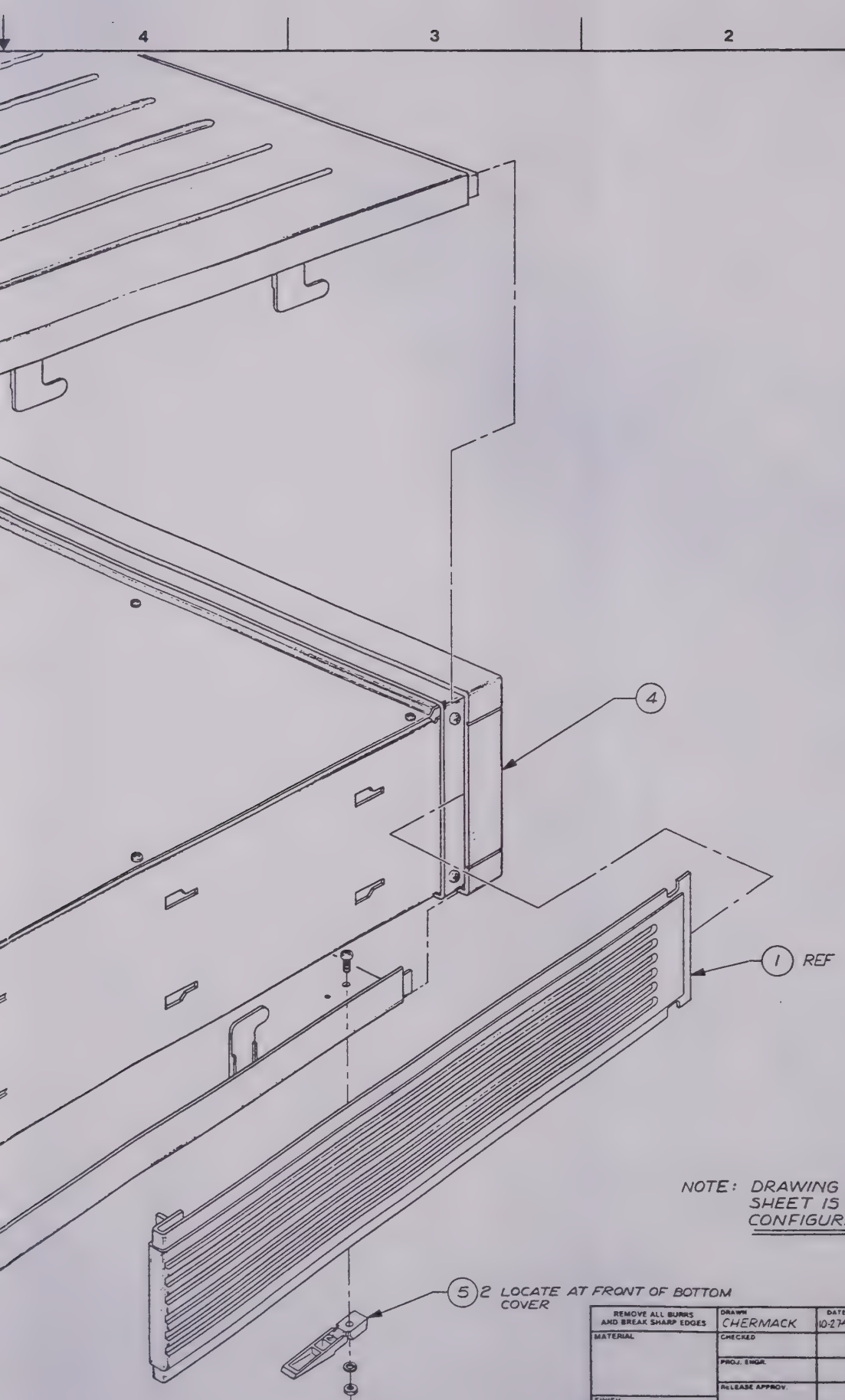
NOTE: DRAWING CONTENT SHOWN ON THIS SHEET IS APPLICABLE TO -04 AND ON CONFIGURATIONS ONLY.

REAR COVER

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 10-27-92	WAVETEK San Diego, California
MATERIAL	CHECKED		TITLE: ASSEMBLY DRAWING, INSTRUMENT
	PROJ. ENGR.		
FINISH: WAVE EK PROCESS	RELEASE APPROV.		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± °		SIZE D · FSCM NO. 23338 · DWG. NO. 1001-00-0675 · REV C · SCALE NONE · MODEL 295 · SHEET 3 OF 5

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.





NOTE: DRAWING CONTENT SHOWN ON THIS SHEET IS APPLICABLE TO -02 AND-03 CONFIGURATIONS ONLY.

CATE AT REAR
BOTTOM COVER

REV	ECO	BY	DATE	APP

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 10-27-92
MATERIAL	CHECKED	
	PROJ. ENGR.	
	RELEASE APPROV.	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± °	
DO NOT SCALE DRAWING		

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: ASSEMBLY DRAWING, INSTRUMENT

SIZE	FSCM NO.	DWG NO.	REV
D	23338	1001-00-0675	C

SCALE NONE | MODEL 295 | SHEET 4 OF 5

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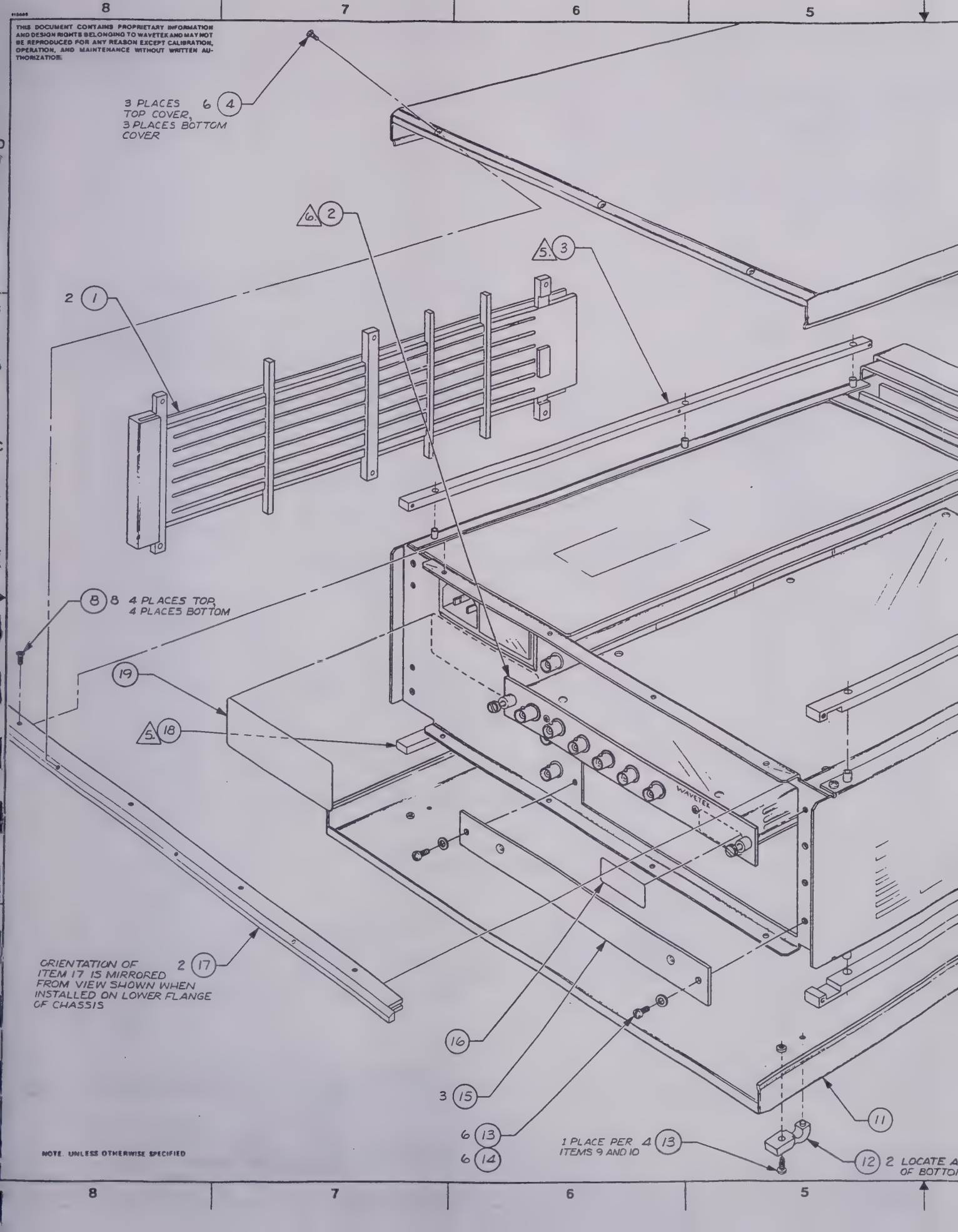
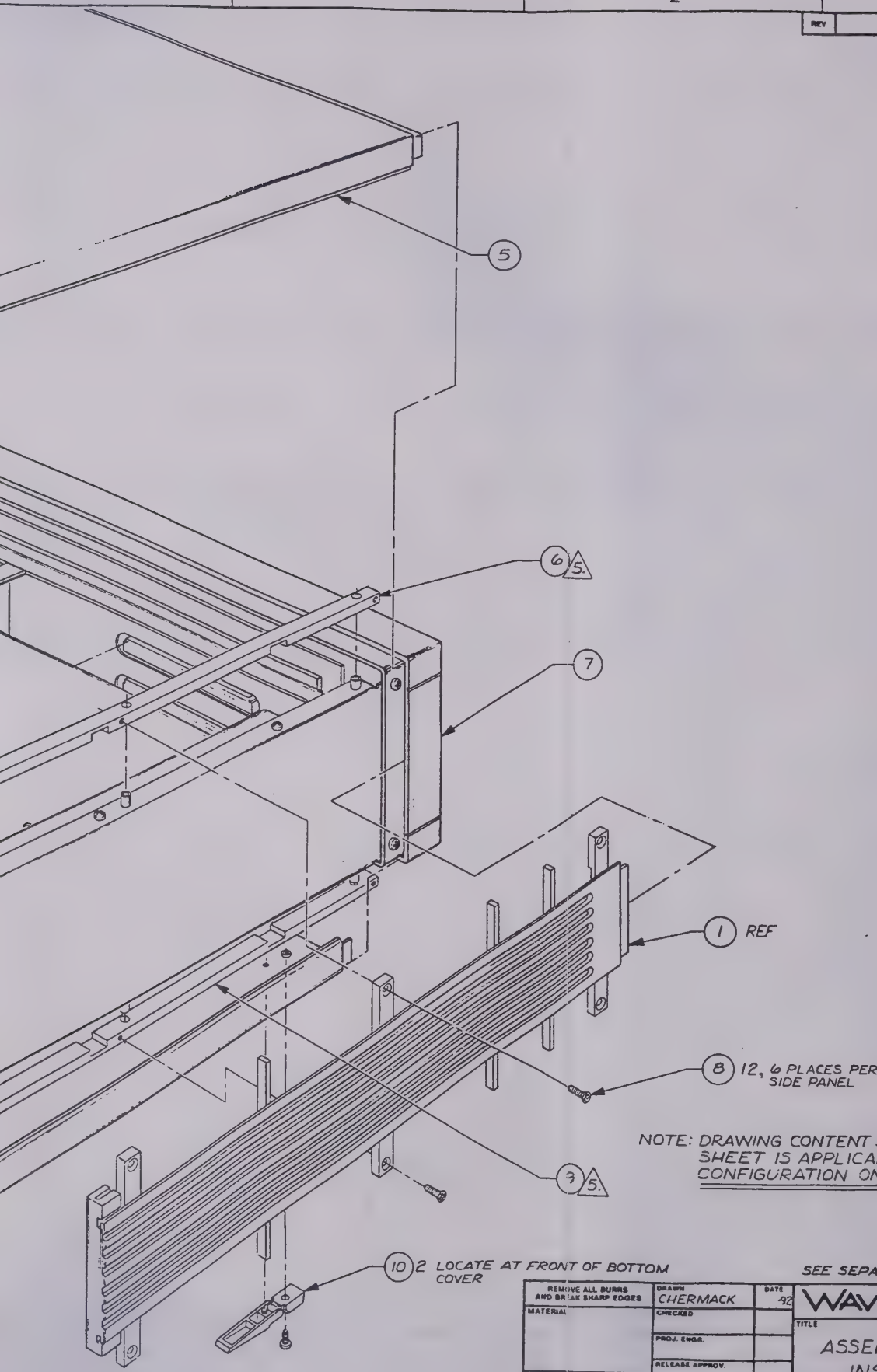


NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP



NOTE: DRAWING CONTENT SHOWN ON THIS SHEET IS APPLICABLE TO -01 CONFIGURATION ONLY.

SEE SEPARATE PARTS LIST.

EAR
OVER

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 92
MATERIAL	CHECKED	
	PROJ. ENGR.	
	RELEASE APPROV.	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	
DO NOT SCALE DRAWING		

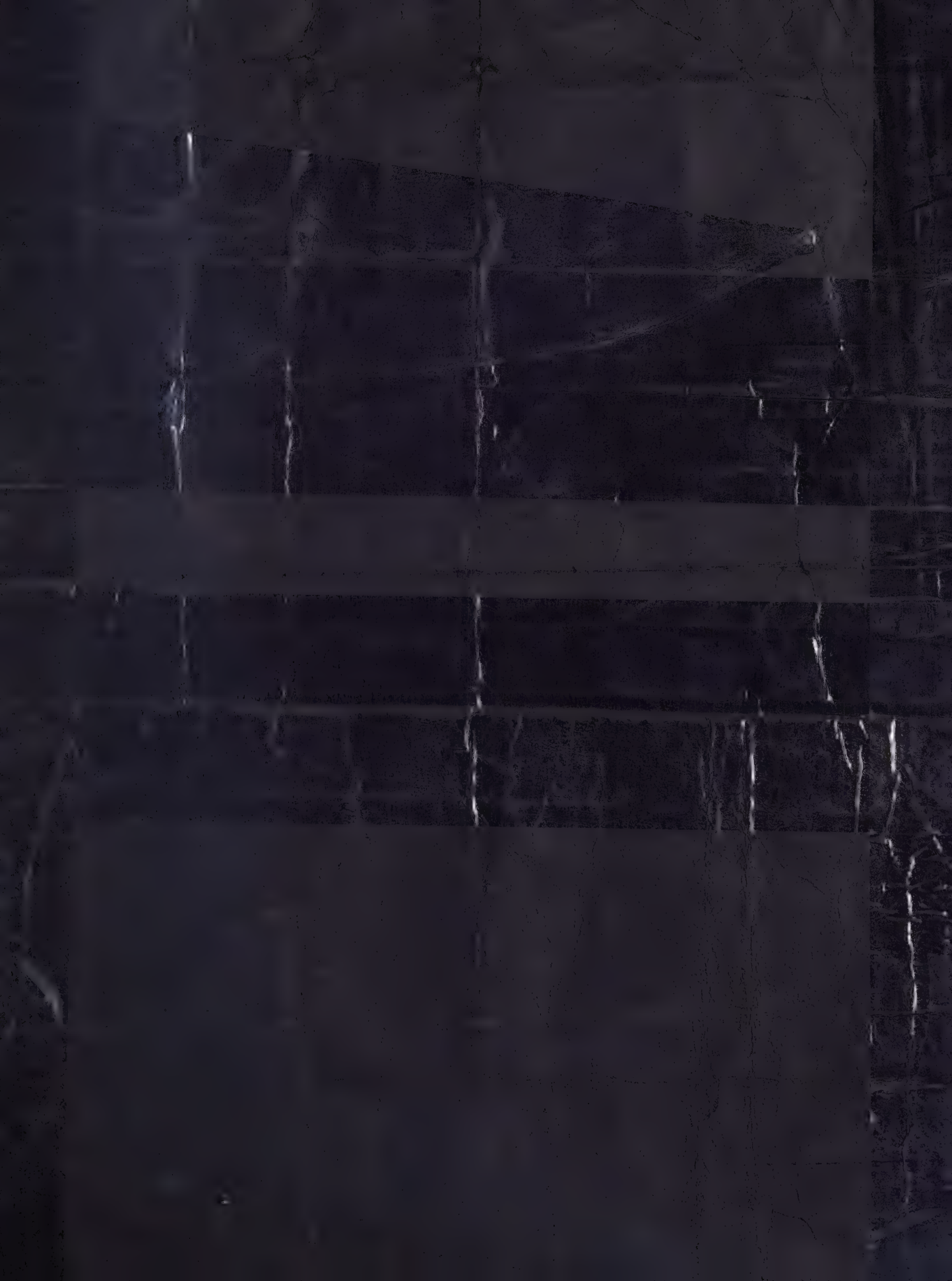
WAVETEK SAN DIEGO, CALIFORNIA

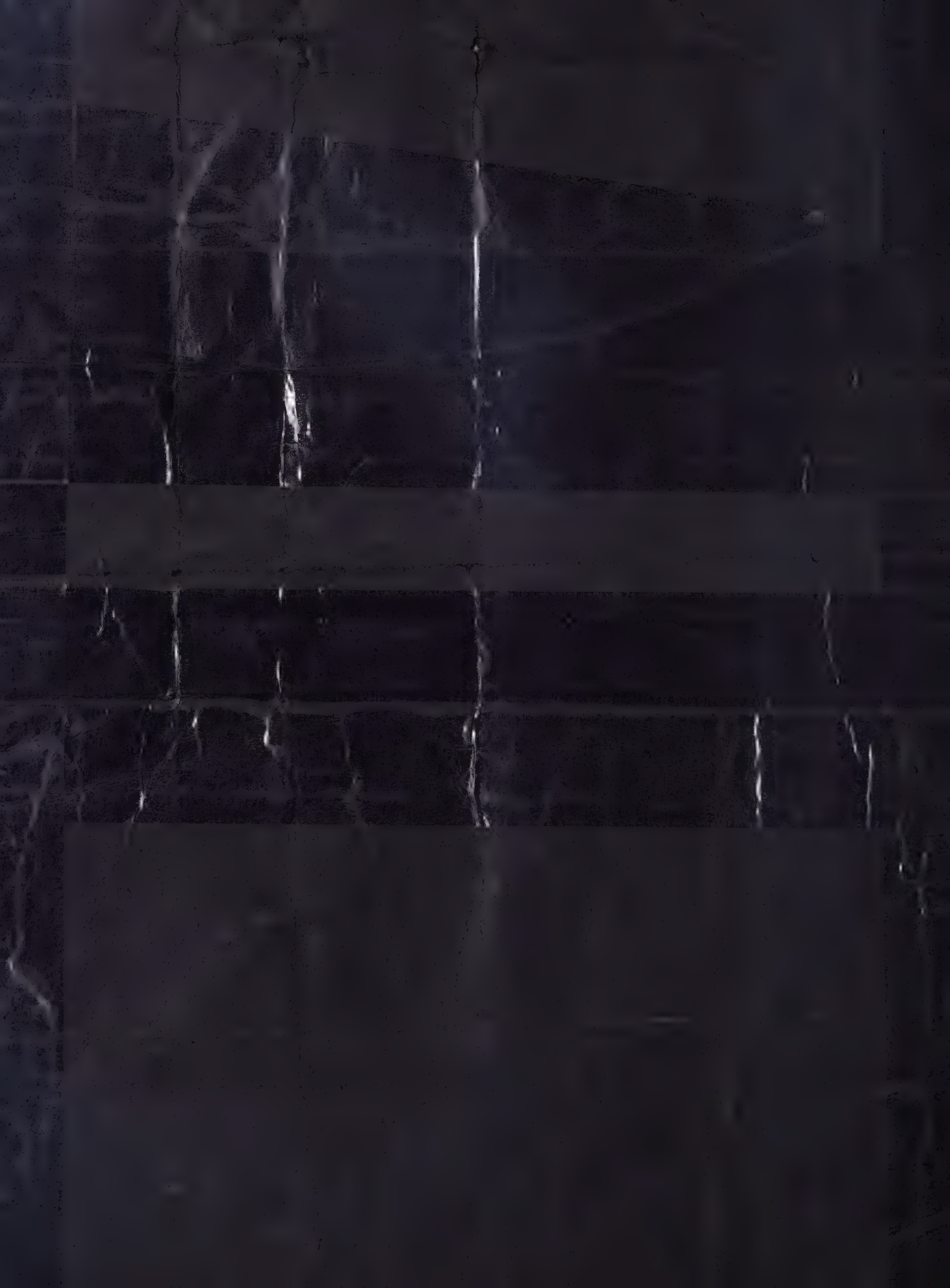
TITLE

ASSEMBLY DRAWING, INSTRUMENT

SIZE	FSCM NO.	DWG. NO.	REV
D	23338	1001-00-0675	C

SCALE NONE | MODEL 295 | SHEET 5 OF 5





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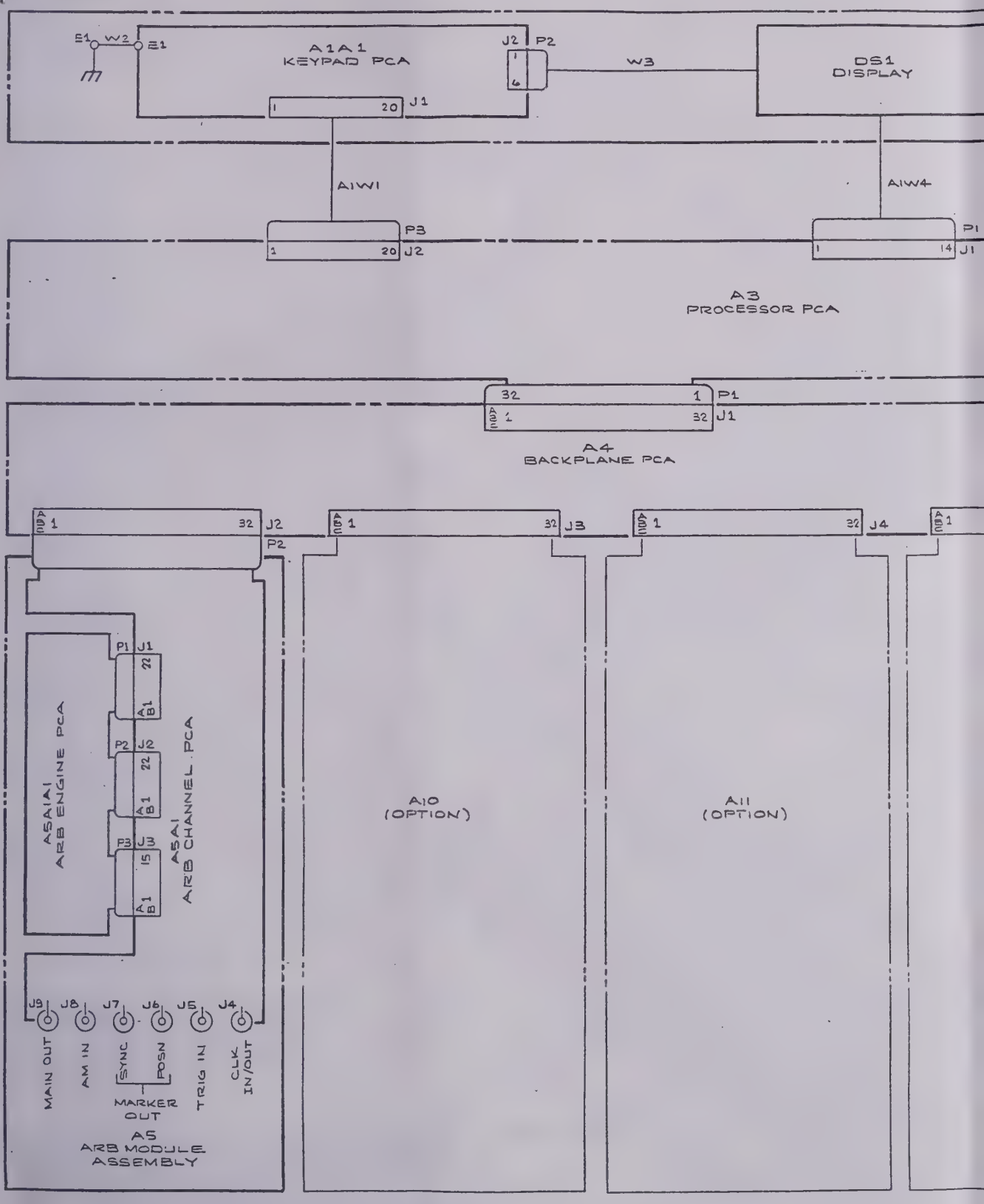


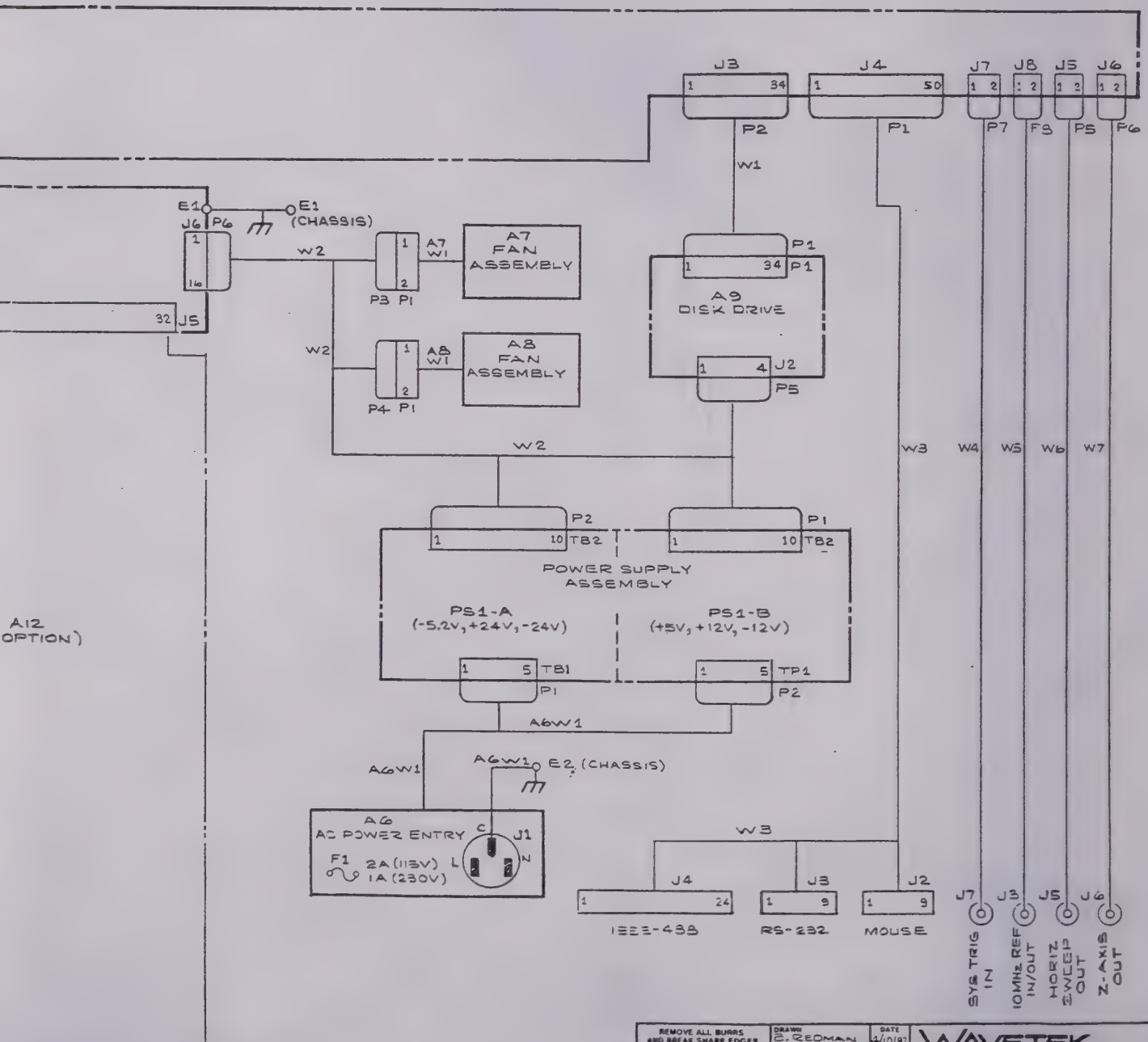
1. ASSEMBLY REFERENCE DESIGNATIONS NOT USED: A2.

NOTE UNLESS OTHERWISE SPECIFIED

INTERCONNECT CA

REV	ECO	BY	DATE	APP
A	ERO 94-0203	B.R	1-20/94	

A1
FRONT PANEL
ASSEMBLY



A12
OPTION)

LING

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN C. REDMAN	DATE 4/10/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL —	CHECKED	6-9-92	TITLE INSTRUMENT SCHEMATIC
	PROJ ENGR.	4/1/92	
FINISH WAVETEK PROCESS —	RELEASE APPROV.	4/1/92	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES = XX ± XXX ±		SIZE D · FSCM NO 23338 · DWG NO 1004-00-0675 · REV A · SCALE NONE · MODEL 235 · SHEET 1 OF 2

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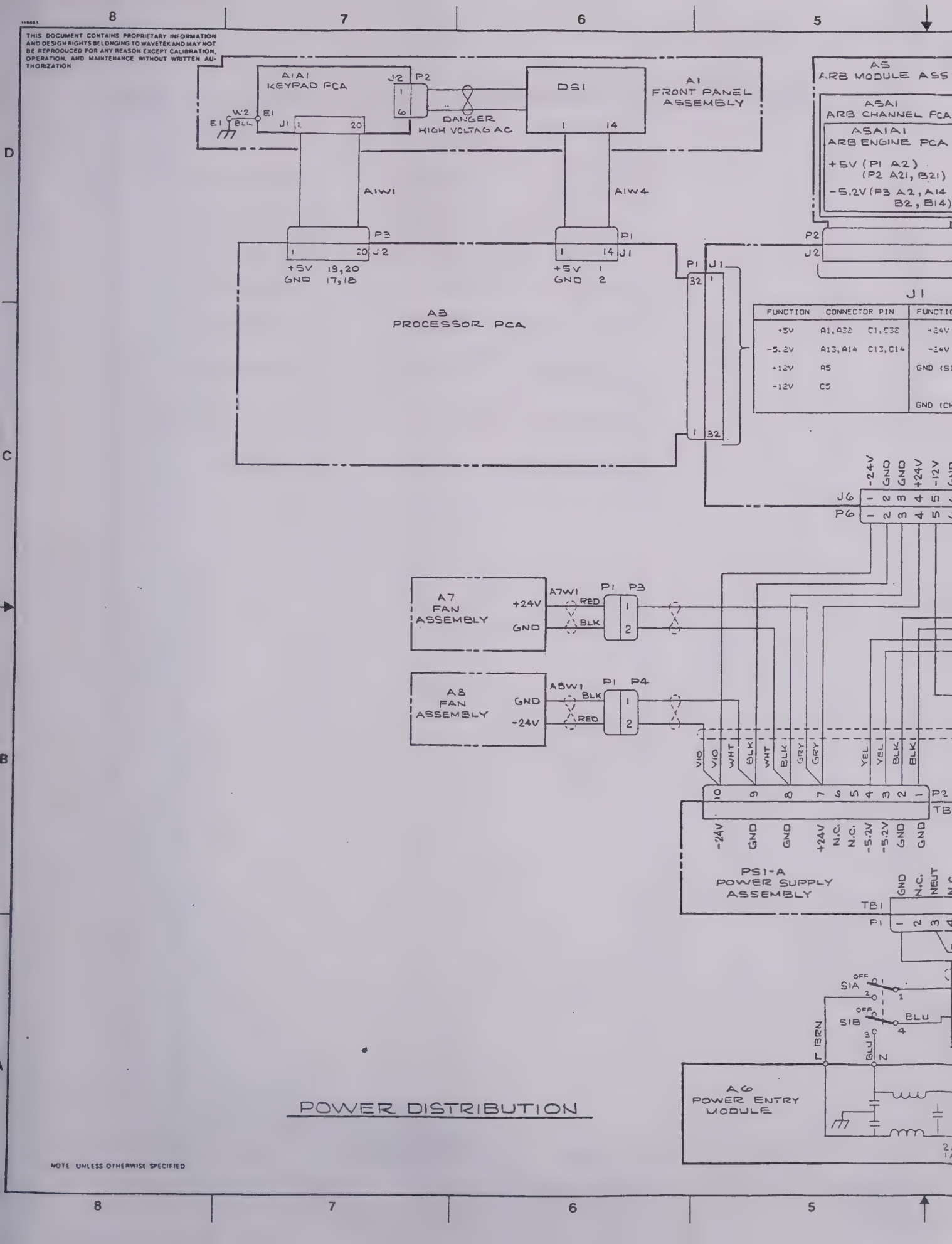
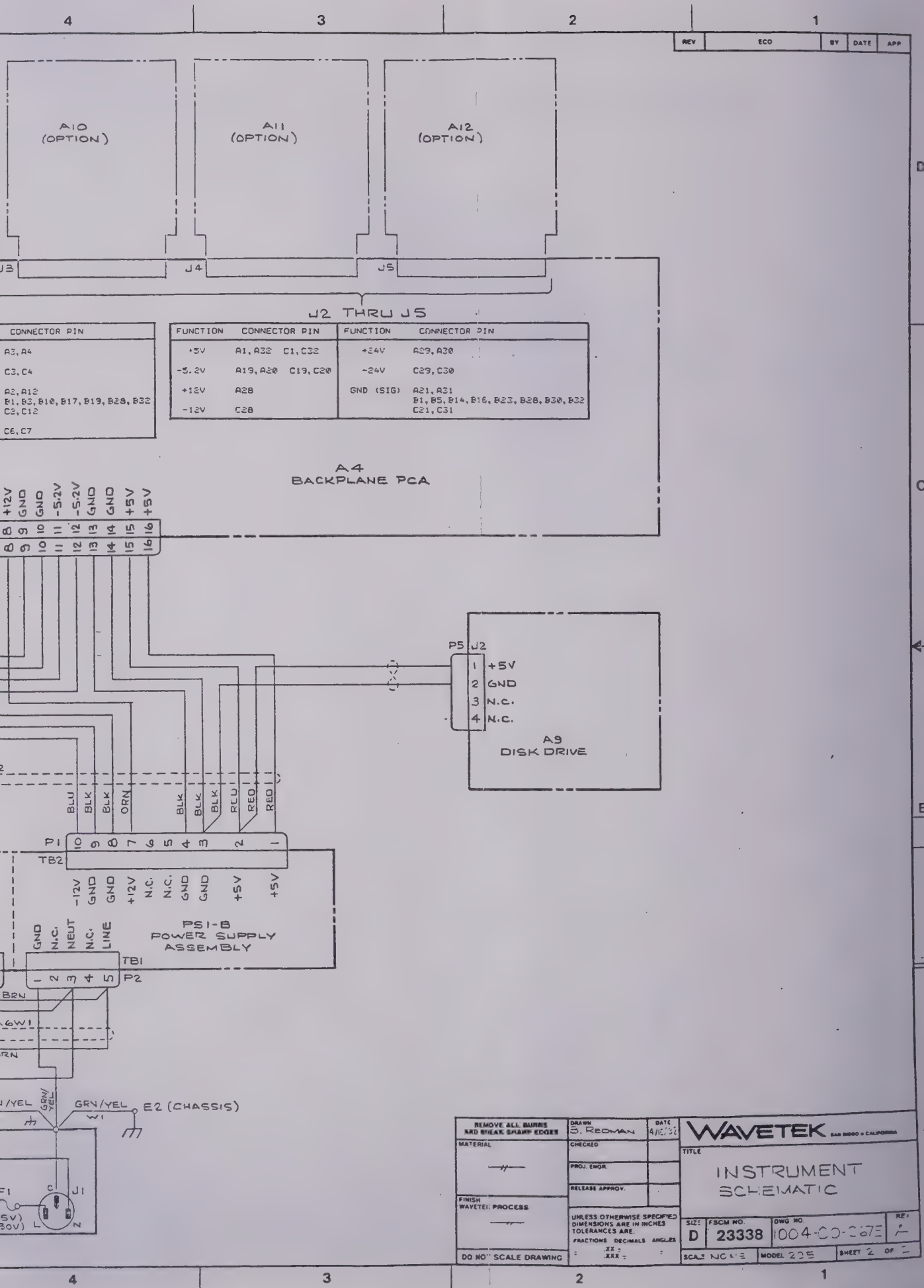


POWER DISTRIBUTION

NOTE UNLESS OTHERWISE SPECIFIED


REV ECO BY DATE APP
A10 (OPTION)
A11 (OPTION)
A12 (OPTION)
J3 J4 J5
J2 THRU J5
CONNECTOR PIN
A3, A4
C3, C4
A2, A12
B1, B3, B10, B17, B19, B28, B32
C2, C12
C6, C7
FUNCTION CONNECTOR PIN
+5V A1, A32 C1, C32
-5.2V A19, A20 C19, C20
+12V A28
-12V C28
FUNCTION CONNECTOR PIN
+24V A29, A30
-24V C29, C30
GND (SIG) A21, A31
B1, B5, B14, B16, B23, B28, B30, B32
C21, C31
A4
BACKPLANE PCA
8 +12V
9 GND
10 GND
11 -5.2V
12 -5.2V
13 GND
14 GND
15 +5V
16 +5V
P5 J2
1 +5V
2 GND
3 N.C.
4 N.C.
A9
DISK DRIVE
BLU
BLK
BLK
ORN
BLK
BLK
BLK
RED
RED
RED
P1
TB2
-12V
GND
GND
+12V
N.C.
N.C.
GND
GND
+5V
+5V
PS1-B
POWER SUPPLY
ASSEMBLY
GND
N.C.
NEUT
N.C.
LINE
TB1
P2
BRN
GRN/YEL
GRN/YEL
W1
E2 (CHASSIS)
J1
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN S. REDMAN 4/12/82
CHECKED
PROJ. ENGR.
RELEASE APPROV.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE.
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
INSTRUMENT SCHEMATIC
SIZE D
FSCM NO. 23338
DWG NO. 1004-00-2673
REV A
SCALE NONE
MODEL 225
SHEET 2 OF 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
2	PCA, ARB ENGINE, 32K WORD	1100-00-3674-01	WVTK	1100-00-3674-01	1
9	PCA,CHANNEL BD	1100-00-3679-01	WVTK	1100-00-3679-01	1
REF	A/D ARB MODULE-295	1101-00-3561	WVTK	1101-00-3561	1
6	FACEPLATE, ARB MODULE	1400-02-5175	WVTK	1400-02-5175	1
1	SHIELD, MODULE - 295	1400-02-5195	WVTK	1400-02-5195	1
3	SHIELD, SYNTHESIZER, CHANNEL BD	1400-02-5239	WVTK	1400-02-5239	1
10	BRACKET, MODULE (EMI SHIELDING)	1400-02-5255	WVTK	1400-02-5255	1
5	SCREW, F.H. CAD I, CROSS RECESS, 6-32 X 3/8	6-32 X 3/8 F.H.	CMRCL	2800-19-6106	2
8	SCREW,4-40X3/16,PHP,NYLOK PATCH	4-40 X 3/16	CMRCL	2800-23-4103	8
7	SCREW,4-40X1/4,PHP,NY LOCK PATCH,Z 4-40X1/4	4-40 X 1/4	CMRCL	2800-23-4104	2

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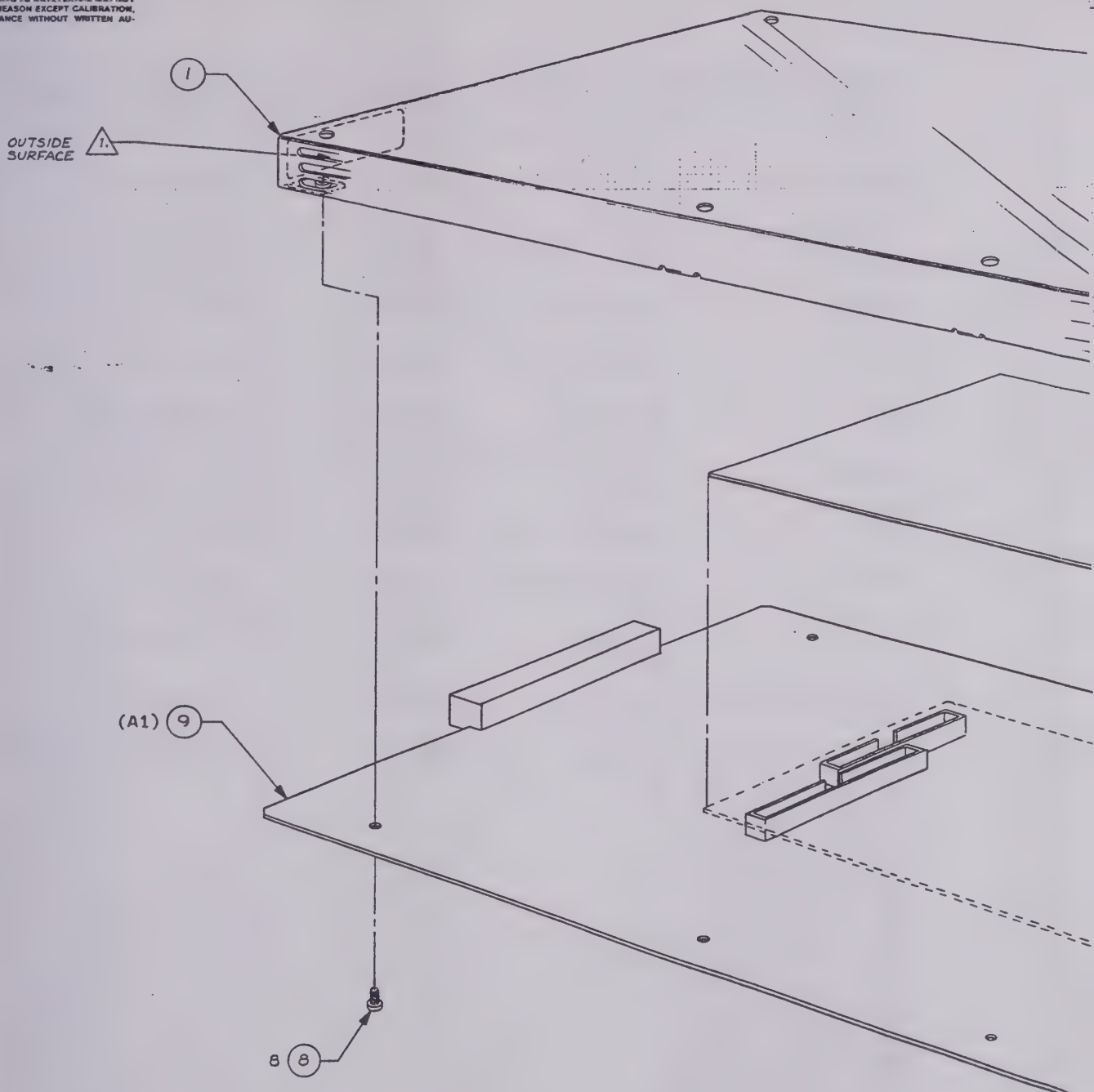
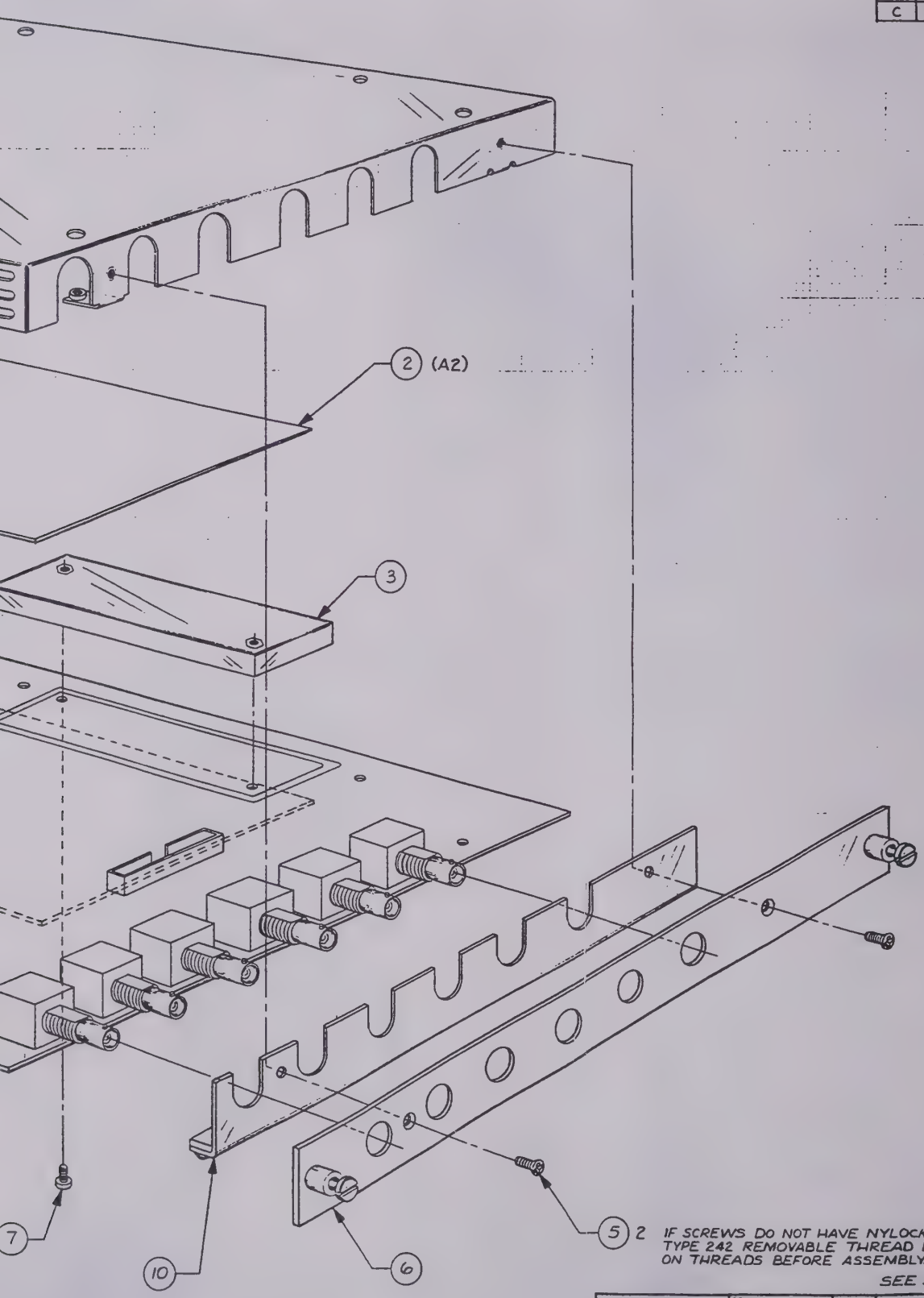


3. PARTIAL REFERENCE DESIGNATIONS SHOWN. PREFIX WITH ASSY REF DES A5.
2. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
1. MARK ASSY WITH PART NUMBER, REVISION LEVEL, DATE CODE AND SEQUENCE NUMBER (OPTIONAL) IN APPROX. AREA SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-253	SC	5-1-92	RJH
B	ECO 93-005	SC	10-22-92	RM
C	ECO 93-251	SC	8-18-93	RM



IF SCREWS DO NOT HAVE NYLOCK PATCH, APPLY LOCTITE TYPE 242 REMOVABLE THREAD LOCKER (WVTK#1600-03-0016) ON THREADS BEFORE ASSEMBLY.

SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 2-11-92
MATERIAL	CHECKED B. REDMAN	5-5-92
	PROJ. ENGR. RBG	5-5-92
	RELEASE APPROV. RJH	5-5-92
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX ± .XXX ± ±	
DO NOT SCALE DRAWING		

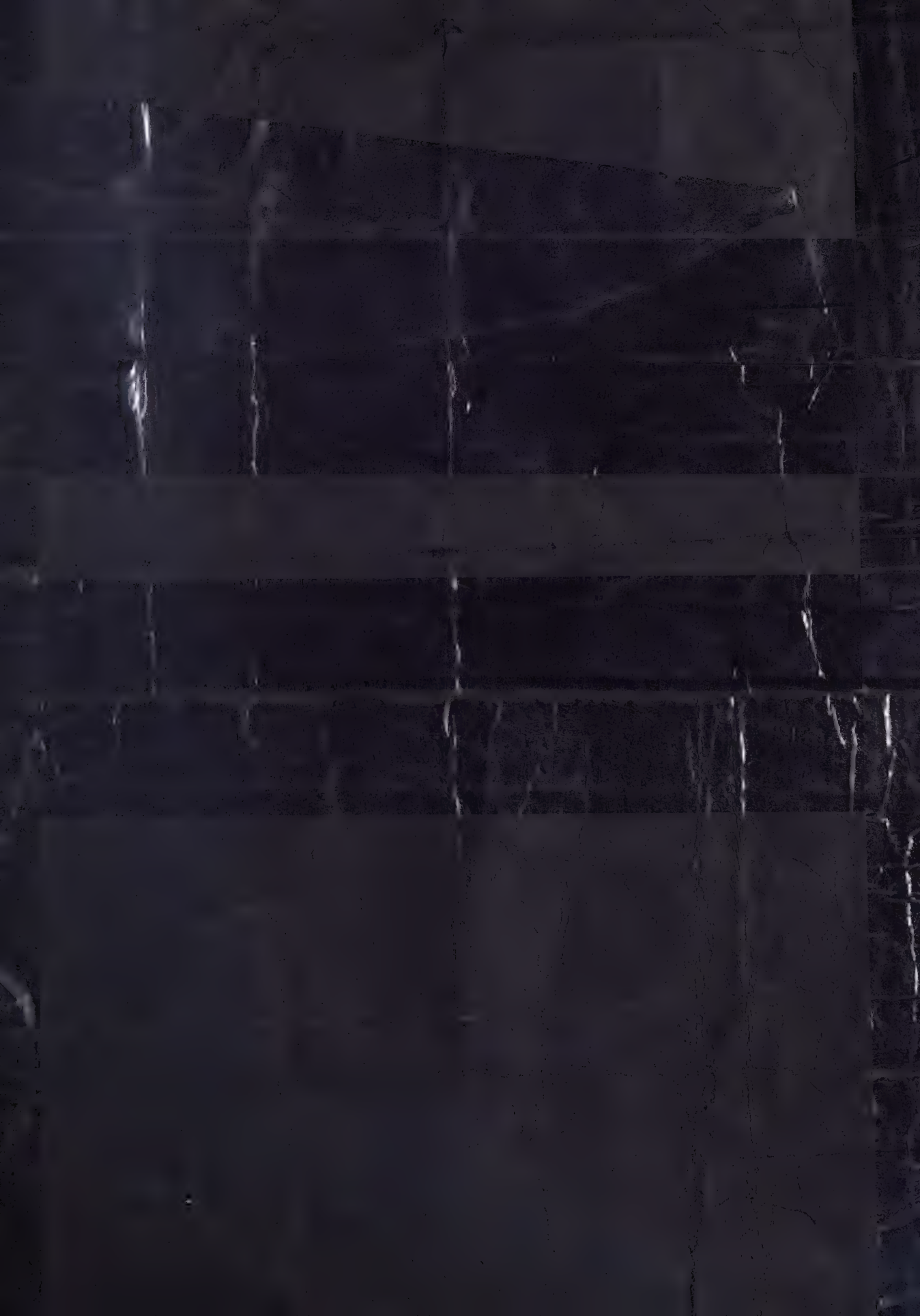
WAVETEK SAN DIEGO, CALIFORNIA

TITLE: ASSEMBLY, ARB MODULE (A5)

SIZE	FSCM NO.	DWG NO.	REV
D	23338	1101-00-3561	C

SCALE NONE | MODEL 295 | SHEET 1 OF 1

4 3 2 1



REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R168 R228	RES,MF,1/8W,1%,402 OHM	RN55D4020F	DALE	0586-04020	2
R178 R194 R260 R352	RES,MF,1/4W,1%,182 OHM	RN60D1820F	DALE	0587-01820	4
R275 R276 R277 R353	RES,MF,1/4W,5%,13 OHM	CCF070130J	DALE	0595-00130	4
R366	RES,MF,1/4W,5%,51 OHM	CCF070510J	DALE	0595-00510	1
R293 R297	RES,MFLM 115 OHM 1% 1/8W T0	RN55C1150F	UNCEM	110.1150	2
R288 R291	RES,MFLM 169 OHM 1% 1/10W T2	RN55C1690F	UNCEM	110.1691	2
REF	A/D CHANNEL BD	1101-00-3679	WVTK	1101-00-3679	1
REF	SCHEMATIC,CHANNEL BD	1104-00-3679	WVTK	1104-00-3679	1
R292 R296	RES,MFLM 6.34K 1% 1/10W T2	RN55C6341F	UMCEM	111.6341	2
R203	RES,MFLM 70.27K .1% 1/8W T0	HA55 100PPM	HYMEG	112.7028	1
RN5 RN6	RES,NETWORK, 10K OHM 1% X8	698-3-R10K-F	BECK	128.3103	2
C53 C59 C61	CAP,CER,.001 MF,+-10%,50V,X7R,.1" LS	SR155C102KAA	AVX	1500-01-0207	3
C122 C129 C130 C133 C303 C304 C54 C57	CAP,CER,.01MF,+-10%,50V,X7R,.1"LS	SR155C103KAA	AVX	1500-01-0307	8
C10 C100 C103 C104 C107 C108 C109 C110 C112 C113 C114 C115 C116 C117 C118 C119 C12 C120 C124 C125 C127 C131 C134 C135 C136 C138 C139 C14 C140 C141 C142 C143 C144 C145 C146 C148 C149 C15 C150 C151 C152 C153 C154 C155 C157 C158 C159 C16 C161 C162 C163 C165 C167 C17 C170 C171 C172 C173 C174 C175 C176 C177 C178 C179 C18 C180 C181 C182 C183 C184 C185 C186 C187 C189 C19 C190 C191 C192 C193 C194 C195 C196 C2 C20 C200 C202 C203 C204 C205 C206 C208 C209 C21 C210 C211 C212 C213 C214 C216 C217 C22 C23 C24 C25 C26 C27 C28 C29 C30 C301 C31 C32 C33 C34 C4 C40 C41 C42 C45 C46 C52 C55 C58 C6 C60 C65 C66 C68 C70 C72 C73 C74 C75 C76 C77 C78 C79 C8 C81 C82 C83 C84 C85 C86 C97 C98 C99	CAP,CER,.1 MF,50V,X7R,+-10%,.1" LS	SR205C104KAA	AVX	1500-01-0415	147
C69 C95	CAP,CER,COG, 50V, 5%, 120 PF, .1 LS	SR155A121JAA	AVX	1500-01-2101	2
C156 C305	CAP,CER,COG, 1.5 PF, 100V, .1 LS	SR155A1R5KAA	AVX	1500-01-5000	2
C199 C94	CAP,CER,COG, 50V, 5%, 150 PF, .1 LS	SR155A151JAA	AVX	1500-01-5101	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C80	CAP,CER,150PF,1KV	DD-151	CRL	1500-01-5111	1
C88 C90	CAP,CER,COG, 50V, 5%, 18 PF, .1 LS	SR155A180JAA	AVX	1500-01-8001	2
C87	CAP,CER,COG, 50V, 5%, 180 PF, .1 LS	SR155A181JAA	AVX	1500-01-8101	1
C35 C44 C89 C92	CAP,CER,COG, 50V, 5%, 220 PF, .1 LS	SR155A221JAA	AVX	1500-02-2101	4
C218	CAP CER MON 2.7PF 50V	CCD2R7DNPO	ARCO	1500-02-7505	1
C96	CAP,CER,COG, 50V, 5%, 390 PF, .1 LS	SR155A391JAA	AVX	1500-03-9102	1
C123 C93	CAP,CER,COG, 50V, 5%, 68PF, .1 LS	SR155A680JAA	AVX	1500-06-8002	2
C302 C91	CAP,CER,COG, 50V, 82PF, .1 LS	SR155A820JAA	AVX	1500-08-2001	2
C1 C11 C13 C3 C5 C63 C7 C9	CAP,ELECT,100MF,35V RADIAL LEAD,SP .20	NRE101M35V10X12.5(OBS)	NIC	1500-31-0102	8
C106 C121 C126 C132 C137 C147 C160 C168 C169 C188 C197 C198 C71	CAP,ELECT,22MF,25V,RADIAL	SRA25VB22RM6X7LL	UNCON	1500-32-2002	13
C62 C64	CAP,ALUM ELECT,470MF,20%,16V,RADAIL .2" SP,10MM DIAx12.5MM HT	KME16VB471M10X12LL	UNCON	1500-34-7114	2
C166 C50	CAP,MET POLY,.001MF,100V	168102K100A	WEST	1500-41-0214	2
C201 C37	CAP,MET POLYS,.1MF,10%,63V,.1"LS	MKS02-0.1MF-10%-63V	WIMA	1500-41-0418	2
C36 C38 C49	CAP,MET POLYS,.33 MF,+-20%,50V,.1"LS	MKS02-.33MF-20%-50V	WIMA	1500-41-0421	3
C39 C43	CAP,MET POLYS,0.01MF,+-20%,63V,.1IN LS	MKS02-0.01MF,20%-63V	WIMA	1500-41-0422	2
C48 C51	CAP,MET,POLY, .033MF 100V 5% .2 LS	168/.033/J/63/A(OBS)	WEST	1500-43-3304	2
C215 C56	CAP,TANT,22MF,15V	196D226X9015KA1(OBS)	SPRAG	1500-72-2601	2
1	PCB, ARB CHANNEL REF: SPEC 0008-00-0455 REV E	1700-00-3679	WVTK	1700-00-3679	1
L5	INDUCTOR,99 NH,5%,Q66	132-07	COILC	1800-00-0050	1
L3 L4	INDUCTOR,FIXED, 345 nH	132-15	COILC	1800-00-0056	2
L2 L6 L7	INDUCTOR,FIXED, 475 nH	132-17	COILC	1800-00-0057	3
L1	INDUCTOR, 117 nH, Q68, AT 25 MHZ FREQ	132-08	COILC	1800-00-0065	1
J4 J5 J6 J7 J8 J9	CONN, BNC(PC)	227161-1	AMP	2100-01-0019	6
P1	CONN, DIN, MALE, 96 PIN, A/B/C,RTA	P196830P00F00ZI	BURND	2100-02-0236	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
J3	HEAD, 26 PIN,DUAL ROW, 0.025 SQ PIN,W/SHRD	TST-113-01-L-D	SAM	2100-02-0308	1
J1 J2	HEAD, 40 PIN,DUAL ROW, 0.025 SQ PIN,W/SHRD	TST-120-01-L-D	SAM	2100-02-0309	2
6	SKT,IC,24PIN	DILB-24P-108	BURND	2100-03-0029	1
2	SOCKET,DUAL BEAM,LO RISE, 24 PIN	802-0241642	WELCN	2100-03-0088	1
TP10 TP11 TP12 TP13 TP14 TP15 TP3 TP5 TP9	TEST POINT,BLK,PC	TP-104-01-00	COMPO	2100-04-0054	9
TP1 TP16 TP17 TP18 TP19 TP2 TP20 TP21 TP22 TP23 TP24 TP25 TP26 TP4 TP6 TP7 TP8	TEST POINT,RED,PC	TP-104-01-02	COMPO	2100-04-0055	17
4	TRANSIPAD	503-075	BIVAR	2800-11-0003	16
7	HEATSINK,TO-5 PKG	7-120BA	IERC	2800-11-0042	8
5	PLUG,HOLE,NATURAL NYLON, 0.40 DIA ROUND HEAD, 0.250 HOLE	207-160351-00	FASTX	2800-35-0012	5
K1 K10 K11 K16 K17 K18 K3	RELAY,2 FORMC,5V,DIP 14	DF2E-DC5V	AROMT	4500-00-0033	7
K12 K13 K14 K15 K2 K4 K5 K7	RELAY,1	HD1E-M-DC5V	AROMR	180 R198	
POT,TOP TRIM,20T,20 68WR20	BECK 4609-90-0024 2 OHM				
R205 R206 R209 R210	RES,C,1/2W,5%,10	RC-1/2-10J	STKPL	4700-25-0100	4
R199 R200 R212 R213	RES,C,1/2W,5%,22	RC-1/2-220J	STKPL	4700-25-0220	4
R155 R160	RES,C,1/2W,5%,2.7	RC-1/2-2R7J	STKPL	4700-25-0279	2
R357 R358 R359 R360	RES,C,1/2W,5%,8.2	RC-1/2-8R2J	STKPL	4700-25-0829	4
R175 R187	RES,C,1/2W,5%,1K	RC-1/2-102J	STKPL	4700-25-1001	2
R252 R253	RES,CC,1/2W,5%,4.7	RC20GF4R7J	AB	4700-99-0088	2
R149 R151 R6	RES,MF,1/8W,.1%,1K	RN55E-1001B	MEPCO	4701-02-1001	3
R152 R153	RES,MFLM,1/8W,.1%,1.1 K	5033RE1101B	MEPCO	4701-02-1101	2
R272	RES,MFLM, 113 OHM, 0.1%, 1/8W, 100 PPM/C	RN55D1130B	BUYOP	4701-02-1130	1
R273	RES,MFLM, 115 OHM, 1/8W, 0.1%, 100 PPM/C	RN55D1150B	BUYOP	4701-02-1150	1
R218 R219	RES,MFLM,1/8W,.1%,301	5033RE3010B	MEPCO	4701-02-3010	2
R267	RES,MFLM, 402 OHM, 0.1%, 1/8W, 100 PPM/C	RN55D4020B	BUYOP	4701-02-4020	1
R204 R4	RES,MF,1/8W,.1%,9K	5023ZE9K00B	MEPCO	4701-02-9001	2
R147 R148 R170 R171 R305 R306 R363 R75 R79 R80	RES,MF,1/8W,1%,100	RN55D-1000F	TRW	4701-03-1000	10
R105 R11 R119 R12 R121 R127 R172 R185 R186 R23 R24 R26 R302 R303 R53 R59	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	16

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R1 R132N R166 R2 R271 R274 R282 R283 R284 R354 R355 R7	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	12
R159 R164 R167 R201 R251 R255 R257 R300 R362 R8 R9	RES,MF,1/8W,1%,100K	RN55D-1003F	TRW	4701-03-1003	11
R120 R145 R146 R158 R161 R162 R179 R181 R182 R189 R190 R191 R192 R195 R196 R197 R231 R27 R279 R28 R280 R281 R29 R298 R299 R30 R304 R350 R351 R54 R62 R71 R72	RES,MF,1/8W,1%,10	5043ED10R100F	MEPCO	4701-03-1009	33
R21	RES,MF,1/8W,1%,110K	RN55D-1103F	TRW	4701-03-1103	1
R100 R118 R124 R135 R144 R248 R34 R45 R46 R48 R50 R96	RES,MF,1/8W,1%,121	RN55D-1210F	TRW	4701-03-1210	12
R85 R86	RES,MF,1/8W,1%,124	RN55D-1240F	TRW	4701-03-1240	2
R138	RES,MF,1/8W,1%,13K	RN55D-1302F	TRW	4701-03-1302	1
R17 R221	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	2
R128 R129	RES,MF,1/8W,1%,150K	RN55D-1503F	TRW	4701-03-1503	2
R104 R183	RES,MF,1/8W,1%,15	RN55D-15R0F	TRW	4701-03-1509	2
R130 R131 R14	RES,MF,1/8W,1%,15.8K	RN55D-1582F	TRW	4701-03-1582	3
R13	RES,MF,1/8W,1%,16.5K	RN55D-1652F	TRW	4701-03-1652	1
R22	RES,MF,1/8W,1%,169K	RN55D-1693F	TRW	4701-03-1693	1
R19	RES,MF,1/8W,1%,182	RN55D-1820F	TRW	4701-03-1820	1
R10 R102 R103 R137 R169 R290	RES,MF,1/8W,1%,200	RN55D-2000F	TRW	4701-03-2000	6
R232 R233 R234 R301 R36 R69 R93	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	4701-03-2001	7
R15	RES,MF,1/8W,1%,20K	RN55D-2002F	TRW	4701-03-2002	1
R16	RES,MF,1/8W,1%,21.5K	RN55D-2152F	TRW	4701-03-2152	1
R64	RES,MF,1/8W,1%,21.5	RN55D-21R5F	TRW	4701-03-2159	1
R173	RES,MF,1/8W,1%,2.21K	RN55D-2211F	TRW	4701-03-2211	1
R294	RES,MF,1/8W,1%,23.7K	RN55D-2372F	TRW	4701-03-2372	1
R254 R99	RES,MF,1/8W,1%,249	RN55D-2490F	TRW	4701-03-2490	2
R188	RES,MF,1/8W,1%,2.49K	RN55D-2491F	TRW	4701-03-2491	1
R174 R229 R266	RES,MF,1/8W,1%,24.9K	RN55D-2492F	TRW	4701-03-2492	3
R176	RES,MF,1/8W,1%,24.9	RN55D-24R9F	TRW	4701-03-2499	1
R285 R287	RES,MF,1/8W,1%,301	RN55D-3010F	TRW	4701-03-3010	2
R262 R264 R289 R91	RES,MF,1/8W,1%,3.01K	RN55D-3011F	TRW	4701-03-3011	4
R361	RES,MF,1/8W,1%,30.1K	RN55D-3012F	TRW	4701-03-3012	1
R356	RES,MF,1/8W,1%,30.1	RN55D-30R1F	TRW	4701-03-3019	1
R134 R142 R87	RES,MF,1/8W,1%,332	RN55D-3320F	TRW	4701-03-3320	3
R256	RES,MF,1/8W,1%,33.2K	RN55D-3322F	TRW	4701-03-3322	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R20	RES,MF,1/8W,1%,37.4K	RN55D-3742F	TRW	4701-03-3742	1
R81	RES,MF,1/8W,1%,392	RN55D-3920F	TRW	4701-03-3920	1
R263	RES,MF,1/8W,1%,4.02K	RN55D-4021F	TRW	4701-03-4021	1
R150 R154	RES,MF,1/8W,1%,432	RN55D-4320F	TRW	4701-03-4320	2
R268	RES, 45.3K OHM, 1%, 1/8W, 100 PPM/C	RN55D4532F	BUYOP	4701-03-4532	1
R136 R143 R25 R31 R32	RES,MF,1/8W,1%,464	RN55D-4640F	TRW	4701-03-4640	5
R18	RES,MF,1/8W,1%,4.64K	RN55D-4641F	TRW	4701-03-4641	1
R156 R65N R76 R77 R78	RES,MF,1/8,1%,499	RN55D-4990F	TRW	4701-03-4990	5
R367	RES,MF,1/8W,1%,4.99K	RN55D-4991F	TRW	4701-03-4991	1
R37 R70	RES,MF,1/8W,1%,499K	RN55D-4993F	TRW	4701-03-4993	2
R141 R246 R247 R249	RES,MF,1/8W,1%,49.9	RN55D-49R9F	CORNG	4701-03-4999	4
R98	RES,MF,1/8W,1%,523	RN55D-5230F	TRW	4701-03-5230	1
R90	RES,MF,1/8W,1%,56.2	RN55D-56R2F	TRW	4701-03-5629	1
R82 R89	RES,MF,1/8W,1%,576	RN55D-5760F	TRW	4701-03-5760	2
R5	RES,MF,1/8W,1%,6.04K	RN55D-6041F	MEPCO	4701-03-6041	1
R133 R3	RES,MF,1/8W,1%,7.15K	RN55D-7151F	TRW	4701-03-7151	2
R163 R165	RES,MF,1/8W,1%,7.32K	RN55D-7321F	WVTK	4701-03-7321	2
R258 R63	RES,MF,1/8W,1%,750	RN55D-7500F	TRW	4701-03-7500	2
R265	RES,MF,1/8W,1%,75K	RN55D-7502F	CORNG	4701-03-7502	1
R259 R286 R68	RES,MFLM,1/8W,1%,75	5033RD75ROF	MEPCO	4701-03-7509	3
R295	RES,MF,1/8W,1%,825	RN55D-8250F	TRW	4701-03-8250	1
R101 R117 R125 R33 R40 R41 R44 R49 R97	RES,MF,1/8W,1%,82.5	RN55D-82R5F	TRW	4701-03-8259	9
R223 R225	RES,MFLM, 165 OHM, 0.1%, 1/4W, 100 PPM/C	RN60D1650B	BUYOP	4701-04-1650	2
R222 R224	RES,MFLM, 169 OHM, 0.1%, 1/4W, 100 PPM/C	RN60D1690B	BUYOP	4701-04-1690	2
R216 R217	RES, 301 OHM, 0.1%, 1/4W, 100 PPM/C	RN60D3010B	BUYOP	4701-04-3010	2
R214 R215	RES, MFLM, 75 OHM, 0.1%, 1/4W, 100 PPM/C	RN60D75R0B	BUYOP	4701-04-7509	2
R269	RES,MFLM, 113 OHM, 0.1%, 1/2W, 100 PPM/C	RN65D1130B	BUYOP	4701-06-1130	1
R270	RES,MFLM, 115 OHM, 0.1%, 1/2W, 100 PPM/C	RN65D1150B	BUYOP	4701-06-1150	1
R184 R250	RES,MF, 1/4W, 1%, 2K OHM	RN60D2001F	BUYOP	4701-13-2001	2
R106 R107 R108 R109 R122 R123 R42 R43 R60 R61	RES,MF,1/2W,1%,100	RN65D-1000F	TRW	4701-23-1000	10
R207 R208 R220	RES, MF,1W,.25%, T2 100	5053RC100R0C	MEPCO	4701-38-1000	3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
RN7	RES NETWORK 10K 2% 10PIN SIP BUSS	4310R-101-103	BOURN	4770-00-0008	1
RN10 RN8 RN9	RES NETWORK 470 10PIN SIP BUSS	4310R-101-471	BOURN	4770-00-0009	3
RN1	RES NETWORK 2.2K 2% 10PIN SIP BUSS	4310R-101-222	BOURN	4770-00-0011	1
RN2	RES NETWORK 1K 2W 16PIN DIP	4116R-001-102	BOURN	4770-00-0019	1
RN3 RN4	RES NETWORK 1K 2% 10PIN SIP BUSS	4310R-101-102	BOURN	4770-00-0022	2
CR1 CR33 CR35	DIODE,ZENER,2.7V,.5W, GLASS	1N4371	MOT	4801-01-4371	3
CR24 CR25	DIODE, ZENER 10V, GLASS SILICON, 1W	1N4740A	MOT	4801-01-4740	2
CR12 CR13 CR2 CR20 CR21 CR22 CR26 CR27 CR32 CR34	DIODE, HIGH CONDUCTANCE, ULTRA FAST	1N5282	FAIR	4801-01-5282	10
CR23 CR28 CR29 CR30	DIODE,1N4002 GEN PURPOSE RECT. 100V,1A	1N4002	FAIR	4801-02-0001	4
CR10 CR15 CR16 CR17 CR18 CR31 CR7 CR8 CR9	DIODE 5082-2811 SCHOTTKY,15V,20MA	5082-2811	HP	4809-02-2811	9
CR3 CR4 CR5 CR6	DIODE,BB909B	BB909B	PHLIP	4899-00-0040	4
DS1	LED,AMBER,RECT BAR	LTL-3251A	LITE	4899-00-0056	1
Q12 Q4	TRANS 2N2219A NPN GENERAL PURPOSE TO-5	2N2219A	NSC	4901-02-2191	2
Q5 Q6	TRANS,SILICON,PLANAR, EPITAXIAL,NPN,TO-18	2N2369A	MOT	4901-02-3691	2
Q13 Q7 Q8	TRANS, NPN, TO-92	PN3563	NSC	4901-03-5630	3
Q10 Q11 Q17 Q18 Q2 Q3	TRANS	2N3866	MOT	4901-03-8660	6
Q19 Q20	TRANS	2N5160-18(OBS)	MOT	4901-05-1600	2
Q15 Q9	TRANS 2N5771 PNP SWITCH TO-92	2N5771	NSC	4901-05-7710	2
Q1	TRANS,FET P CHANNEL	VP0106N3	SUPER	4902-01-0601	1
Q14	TRANSISTOR,PNP,HI FREQ,MED PWR SELECTED	SRF2573	MOT	4902-02-5730	1
Q16	TRANSISTOR,NPN,HI FREQ, MED PWR SELECTED	4902-02-5740	WVTK	4902-02-5740	1
U23 U26	OP AMP,ENHANCED JFET,PRECISION QUAD	TL054CN	TI	7000-00-5400	2
VR1 VR4	VOLT REGULATOR,3 TERMINAL ADJUSTABLE,POS,TO39	LM317H	NSC	7000-03-1710	2
VR2 VR5	VOLT REGULATOR, 3 TERMINAL ADJUSTABLE, NEGATIVE, T0-39	LM337 H	NATNL	7000-03-3701	2
U46	COMPARATORS, QUAD VOLTAGE	LM339N(REF ONLY)	HARIS	7000-03-3900	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U51	OP AMP,PRECISION,WIDEBAND,8-PIN DIP	OPA621KP	BURR	7000-06-2100	1
U50	MULTIPLIER,ANALOG,WIDEBAND	AD834JN	ANDEV	7000-08-3410	1
U18	VOLTAGE REFERENCE, 10V, 8 PIN DIP	LT1021CCN8-10	LINTE	7000-10-2101	1
U16 U17 U57	DARLINGTON ARRAYS, HIGH VOLTAGE, HIGH CURRENT	ULN2003A	SPRAG	7000-20-0300	3
U40 U41 U54 U55	OP,AMP CURRENT FEEDBACK,50mhz	EL2020CN	ELAN	7000-20-2000	4
U21	ADC, 12 BIT	ICL7109CPL	INTSL	7000-71-0900	1
VR3 VR6	REGULATOR, 3 TERMINAL NEG 5V	LM79L05ACZ	NSC	7000-79-0501	2
U22 U25	DAC, 12 BIT, 4 CHAN,SOIC PKG	MB88351PF	FUJI	7000-88-3511	2
U45	COMPARATOR,HIGH SPEED,ECL	AD96685BQ	AD	7000-96-6850	1
U49	OP AMP,HI SLEW RTE,WIDEBND,JFET,PRIME	MC34081AP	MOT	7003-40-8101	1
U24 U58	OP AMP,HI SLEW RTE,WIDEBND,JFET DUAL	MC34082P	MOT	7003-40-8200	2
U28	OP AMP,HI SLEW RTE,WIDEBND JFET	MC34084P	MOT	7003-40-8400	1
NONE	PAL, 16L8, 10 INP, 2 OUT, 6 I/O 5 N TPD, 20 PIN	PAL16L8-5PC	AMD	8000-16-8005	1
NONE	PAL, 16R4, 8 INP, 4 REG OUT, 4 I/O 5 NS TPD, 20 PIN	PAL16R4-5PC	AMD	8000-20-4005	1
U20	MUX/DEMUX, ANALOG	CD4051BE	RCA	8000-40-5100	1
U5	HEX INVERTER	SN74ALS04BN	TI	8000-74-0402	1
U1	HEX INVERTER W/OC	SN74ALS05AN	TI	8000-74-0501	1
U39	GATE,INVER, SCHMITT TRIG, HEX,ACT-CMOS	MC74ACT14N	MOT	8000-74-1431	1
U2 U3 U4	BUFF,OCTAL,NINV,TTL INP/CMOS OUTPUTS	MC74HCT541N	MOT	8000-74-5411	3
U33 U38 U53 LN ECL	MECL 10KH HIGH-SPEED MC10H116P	MC10H102P MOT 8001-01-1601	MOTS	8001-01-0201	3
U35	TRANSLATOR,QUAD TTL-TO-MECL	MC10H124P	MOT	8001-01-2401	1
U36	TRANSLATOR,QUAD TTL-TO-MECL	MC10H125P	MOT	8001-01-2501	1
U32	FLIP-FLOP, DUAL D, MAS/SL, ECL	MC10H131P	MOT	8001-01-3101	1
U30	PLL, ECL	MC12018P	MOT	8001-20-1800	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U10	PROM,EE, 2Kx8,CMOS, 200NS	XL28C16AP-200	EXEL	8002-81-6000	1
U9	DECODER/DEMUX, 3 TO 8 LINE	SN74ALS138N	TI	8007-41-3800	1
U11	BUF/LN DRIVER, OCTAL W/3 STATE	SN74ALS541N	TI	8007-45-4100	1
U12 U13 U14 U15 U19 U56	FLIP-FLOP, OCTAL D	8007-45-7420	WAVET	8007-45-7450	6
U7 U8	TRANSCEIVER, OCTAL BUS W/3 STATE	SN74ALS645A-1N	TI	8007-46-4500	2
U27	PLL SERIES INPUT FREQ SYNTHESIZER	MC145158P(OBS)	MOT	8014-51-5800	1
NONE	GAL,90MA,30NS,24PIN DIP	GAL6001-30	LATT	8060-01-3000	1
U29	OSC EMT CUPLD, ECL	MC1648P	MOT	8100-16-4810	1
U42	GATE ARRAY,COUNTER,SYNCH,MULTI-MODE,32-BIT	CLA53047/BW/DP	PLESS	8700-00-0005	1

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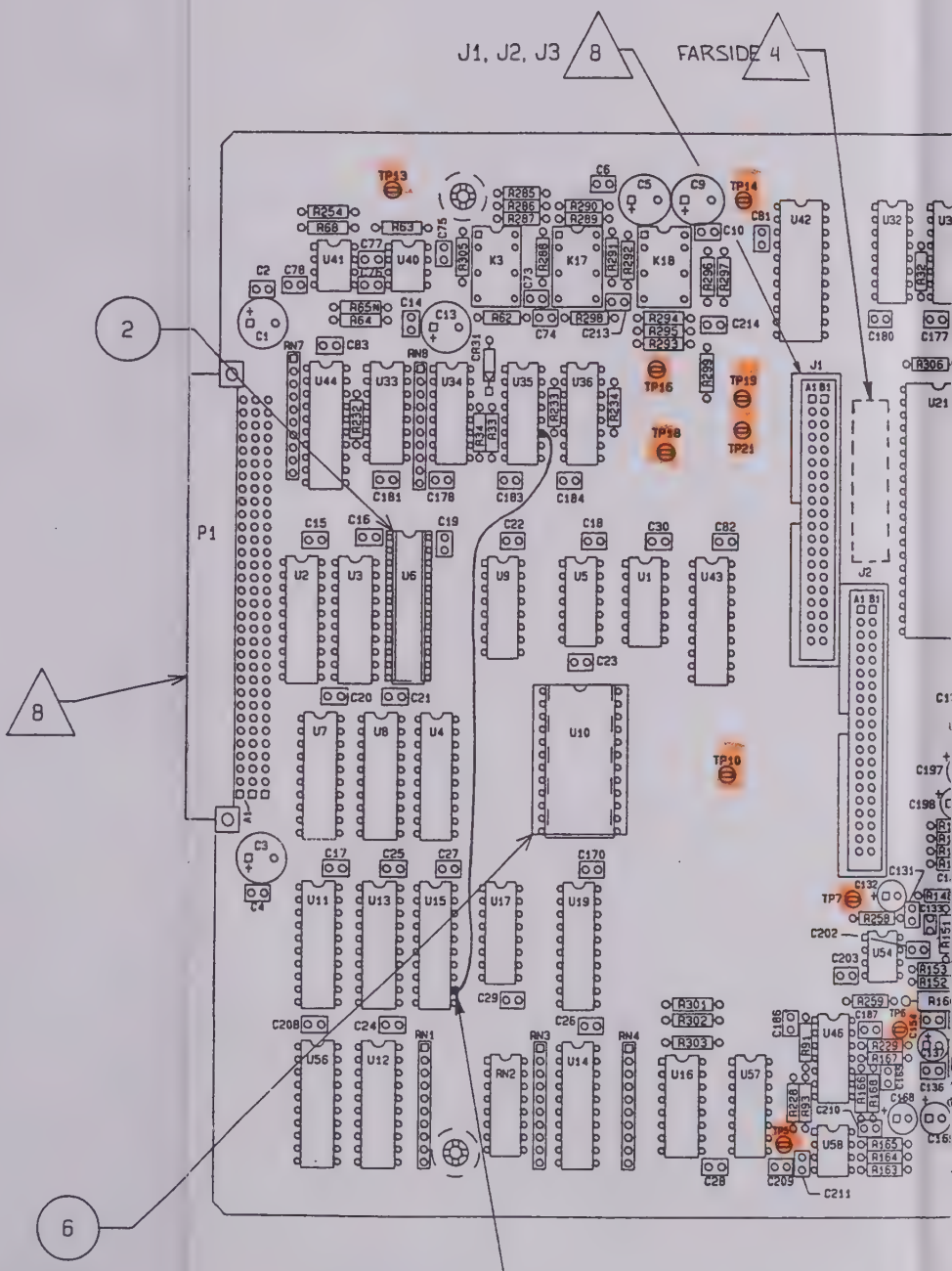
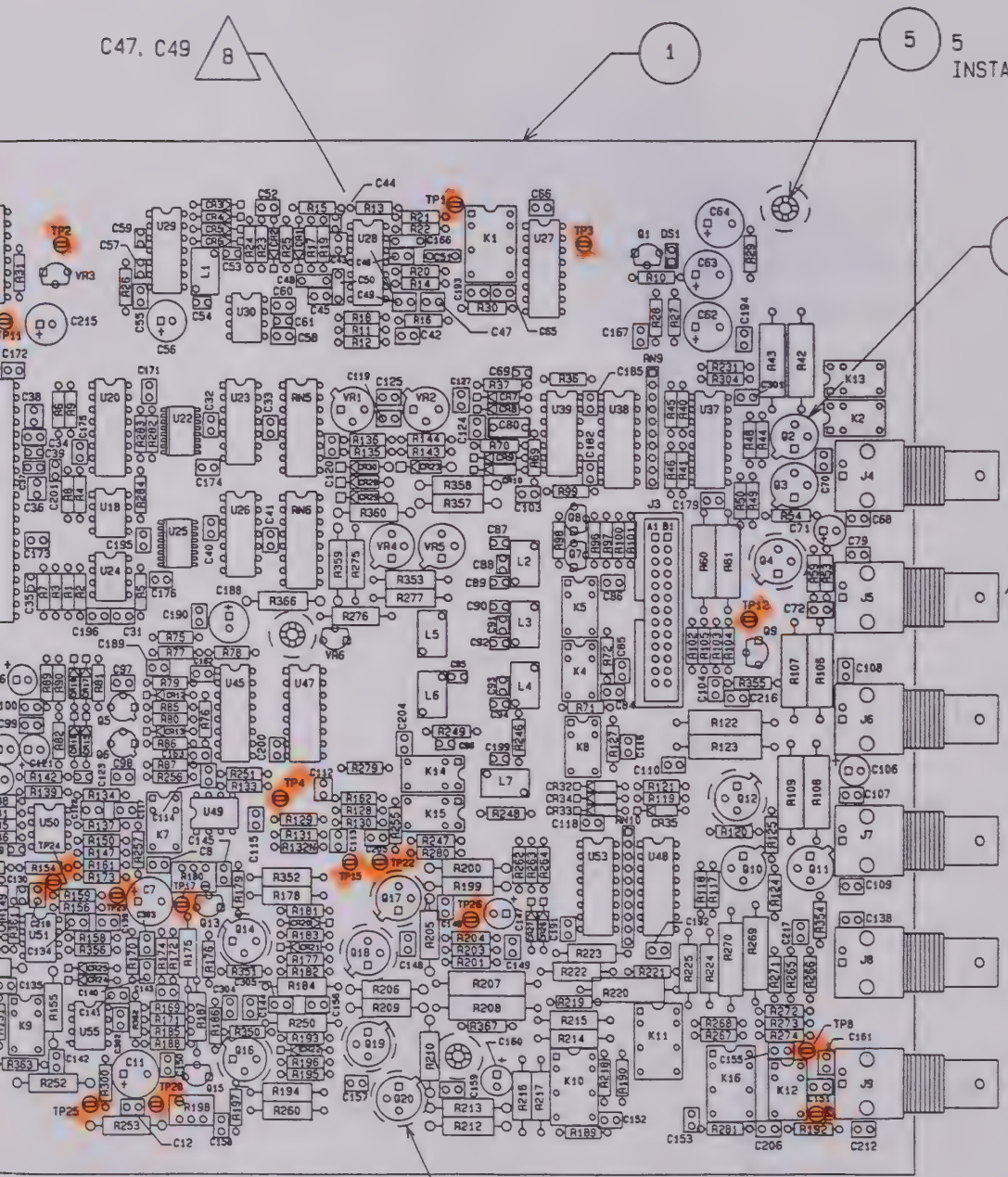


8. THESE PARTS MUST BE FLUSH AGAINST PCB SURFACE AFTER SOLDER.
7. TRIM ALL LEADS TO .050 MAXIMUM, FAR SIDE.
6. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
5. PARTIAL REFERENCE DESIGNATIONS SHOWN. PREFIX WITH ASSY REF DES A1.
4. MARK ASSY WITH PART NUMBER, REVISION LEVEL, DATE CODE, AND SEQUENCE NUMBER (OPTIONAL). IN APPROX. AREA SHOWN.
3. ASSEMBLE PER WAVETEK WORKMANSHIP STANDARDS.
2. FOR ASSY INTERCONNECTION, SEE INSTRUMENT SCHEMATIC 1004-00-0675.
1. SEE 1104-00-3679 FOR SCHEMATIC.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO # 93-112	MP	1-25-93	RAC



CAD JOB #B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN N. MILLER	DATE 11/20/92	WAVETEK San Diego, California
MATERIAL	CHECKED		TITLE ASSY DRAWING, CHANNEL BOARD
	PROJ. ENGR.		
FINISH WAVETEK PROCESS	RELEASE APPROV. R.E. Russell	1/29/93	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ± .XXX ±		SIZE D · FSCM NO. 23338 · DWG NO. 0101-00-3679 · REV A · SCALE · MODEL 245 · SHEET 1 OF 1

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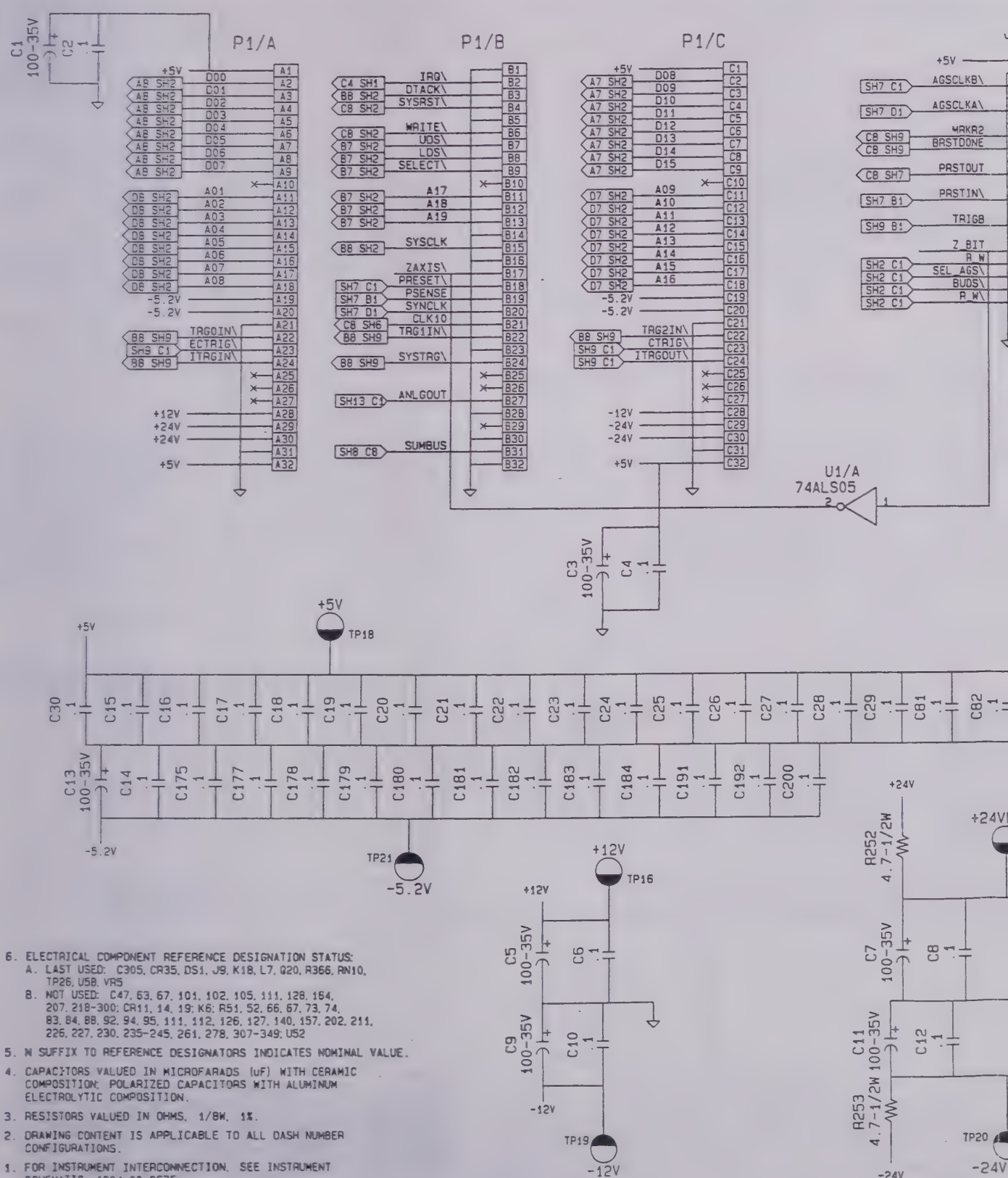
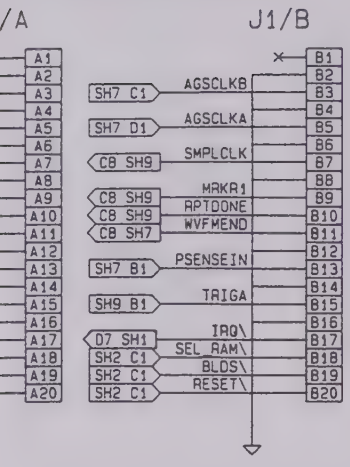
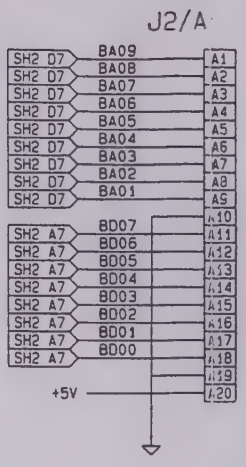


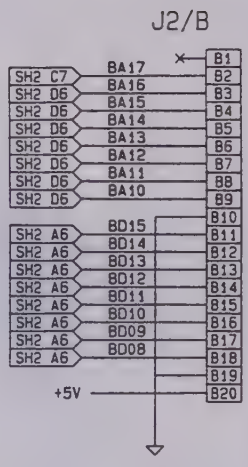
6. ELECTRICAL COMPONENT REFERENCE DESIGNATION STATUS:
   A. LAST USED: C305, CR35, DS1, J9, K18, L7, Q20, R366, RN10, TP26, U58, VR5
   B. NOT USED: C47, 63, 67, 101, 102, 105, 111, 128, 154, 207, 218-300; CR11, 14, 19; K6; R51, 52, 66, 67, 73, 74, 83, 84, 88, 92, 94, 95, 111, 112, 126, 127, 140, 157, 202, 211, 226, 227, 230, 235-245, 261, 278, 307-349; U52
5. N SUFFIX TO REFERENCE DESIGNATORS INDICATES NOMINAL VALUE.
4. CAPACITORS VALUED IN MICROFARADS (uF) WITH CERAMIC COMPOSITION; POLARIZED CAPACITORS WITH ALUMINUM ELECTROLYTIC COMPOSITION.
3. RESISTORS VALUED IN OHMS, 1/8W, 1%.
2. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
1. FOR INSTRUMENT INTERCONNECTION, SEE INSTRUMENT SCHEMATIC, 1004-00-0675

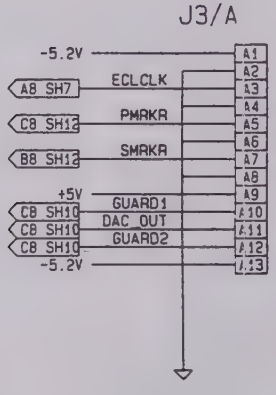
NOTE UNLESS OTHERWISE SPECIFIED

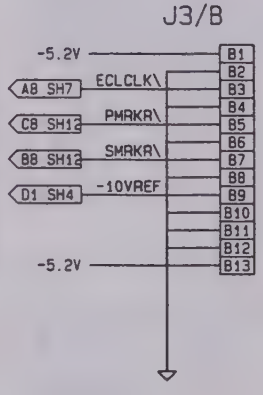
REV	ECO	BY	DATE	APP
A	ERO # 93-112	MP	1-28-93	RGL

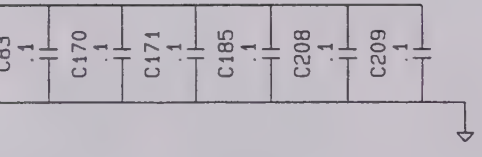












LT

P17

24VFILT

24VFILT

LT

UNUSED GATES	POWER DISTRIBUTION	
U1/D 74ALS05 (9, 8)	REF DES	U1
U1/E 74ALS05 (11, 10)	DEVICE	74ALS05
U1/F 74ALS05 (13, 12)	GND	7
	+5V	14
	BYPASS CAP	C30

CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN PD FIEFER 5/12/87	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED 1/28/88	TITLE SCHEMATIC, CHANNEL BOARD
	PROJ. ENGR. 1/28/88	
FINISH WAVETEK PROCESS	RELEASE APPROV 1/29/88	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ± .XXX ±	SIZE D; FSCM NO 23338; DWG NO 1104-00-3679; REV A; SCALE; MODEL 275; SHEET 1 OF 15

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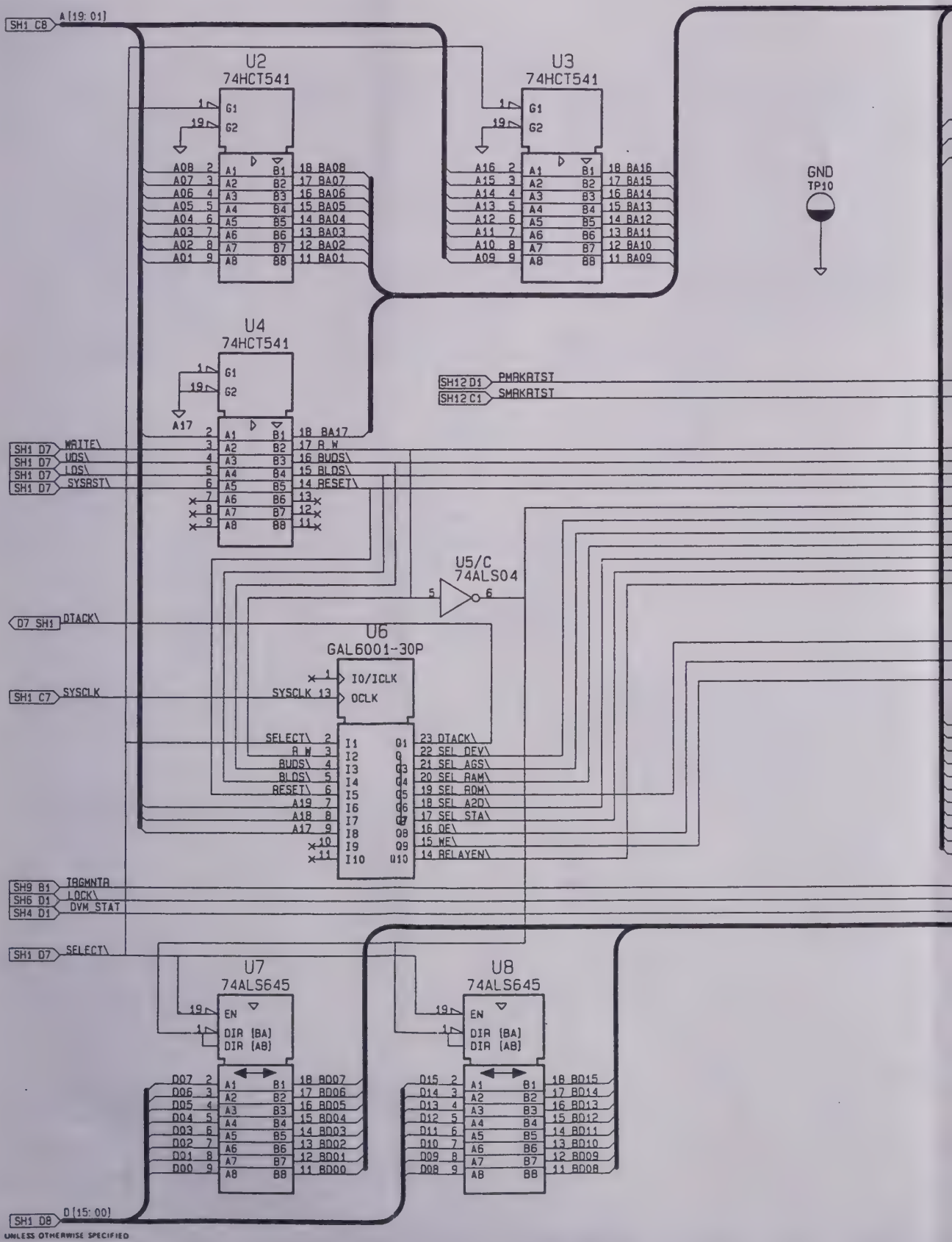
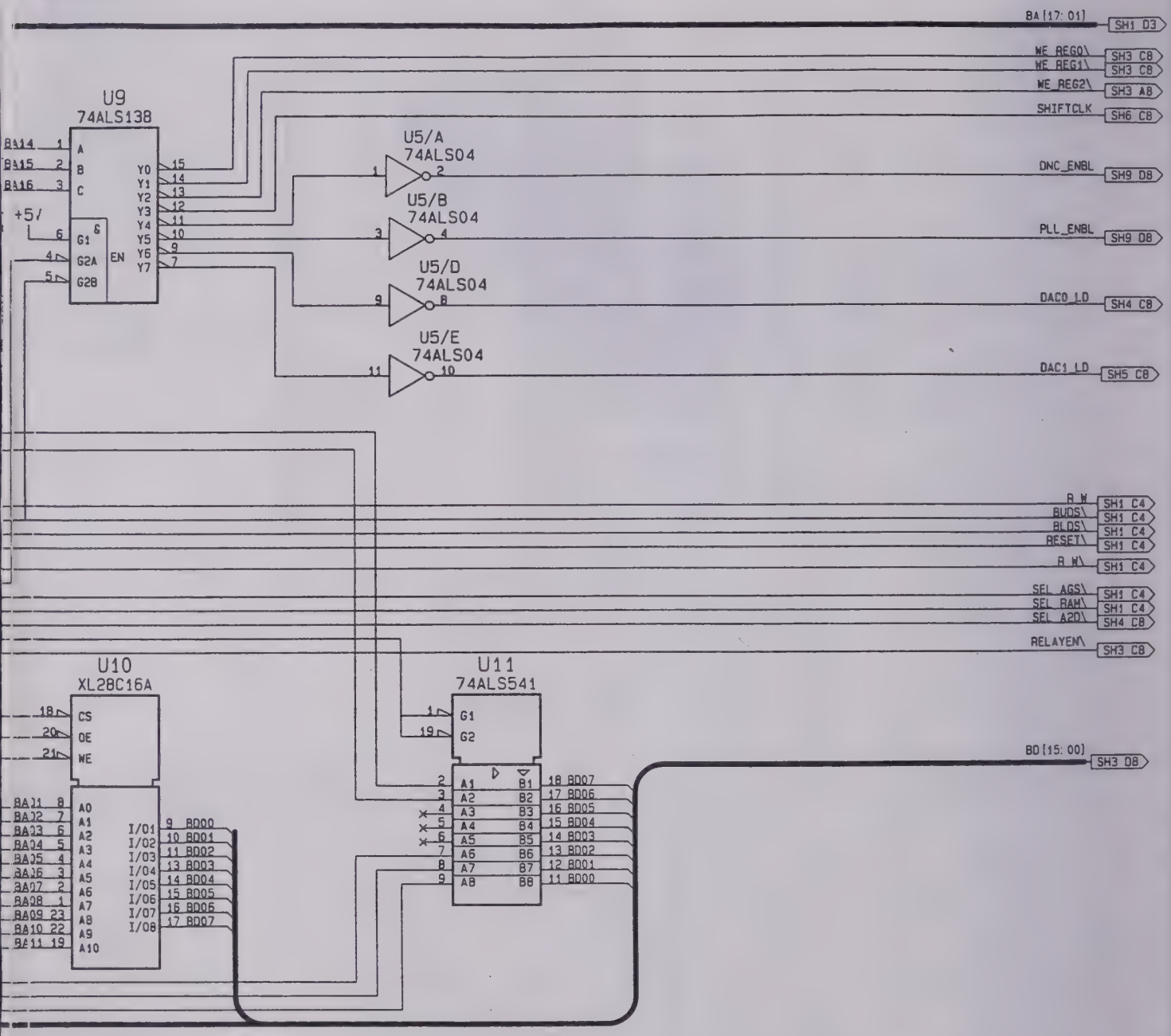


REV	ECO	BY	DATE	APP

R INTERFACE



POWER DISTRIBUTION CHART

REF DES	U2-4	U11	U5	U6	U7, U8	U9	U10
DEVICE	74HCT541	74ALS541	74ALS04	GAL6001	74ALS645	74ALS138	281C16A
GND	10	10	7	12	10	8	12
+5V	20	20	14	24	20	16	24
BYPASS CAP	C15, 16	C17	C18	C19	C20, C21	C22	C23

CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN: RO FIFER 5/12/92
CHECKED
PROJ ENGR
RELEASE APPROV

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
X ± X
XXX ± X

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
SCHEMATIC,
CHANNEL BOARD

SIZE	FSCM NO	DWG NO.	REV
D	23338	1104-00-3679	A

SCALE | MODEL 295 | SHEET 2 OF 15

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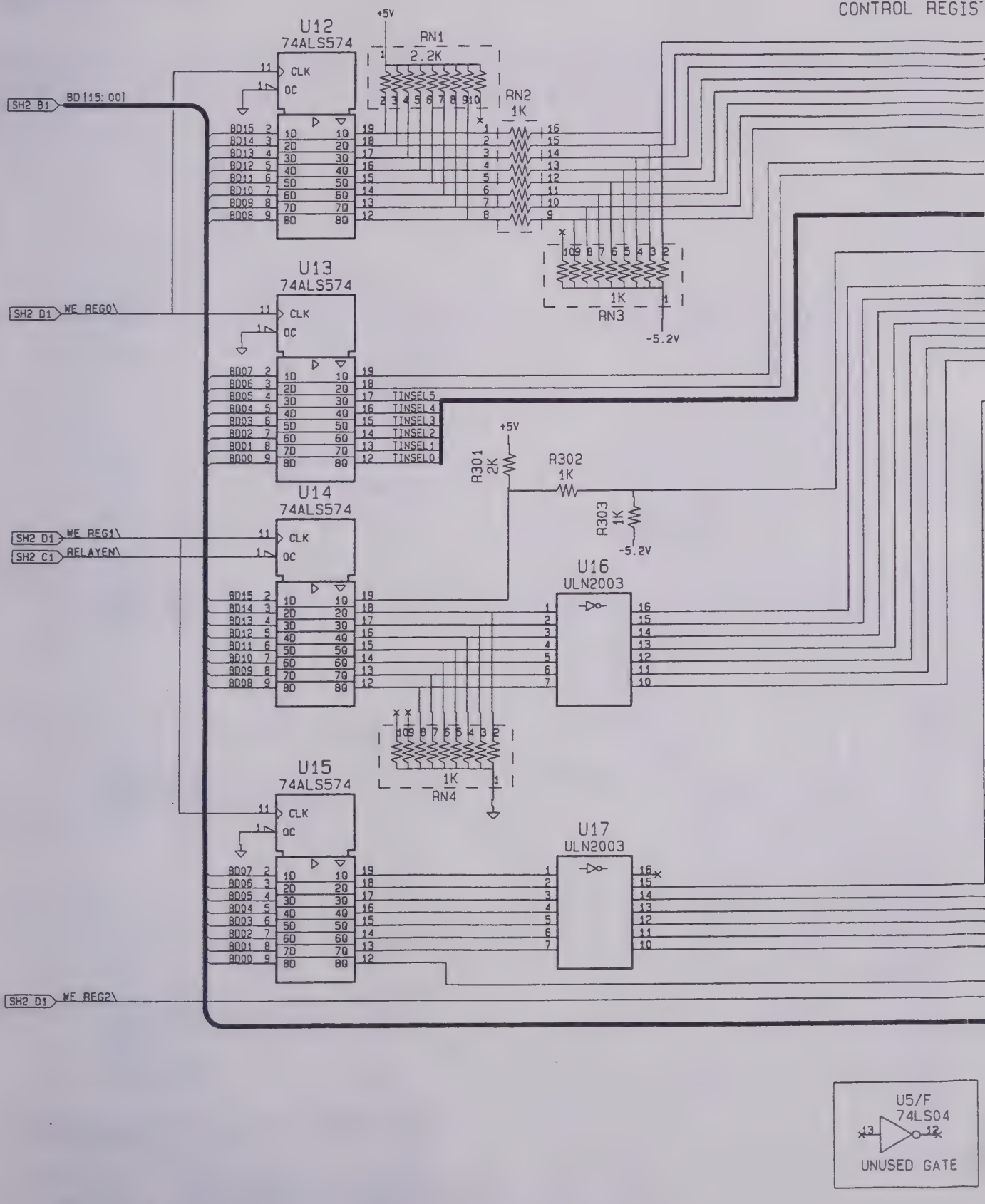
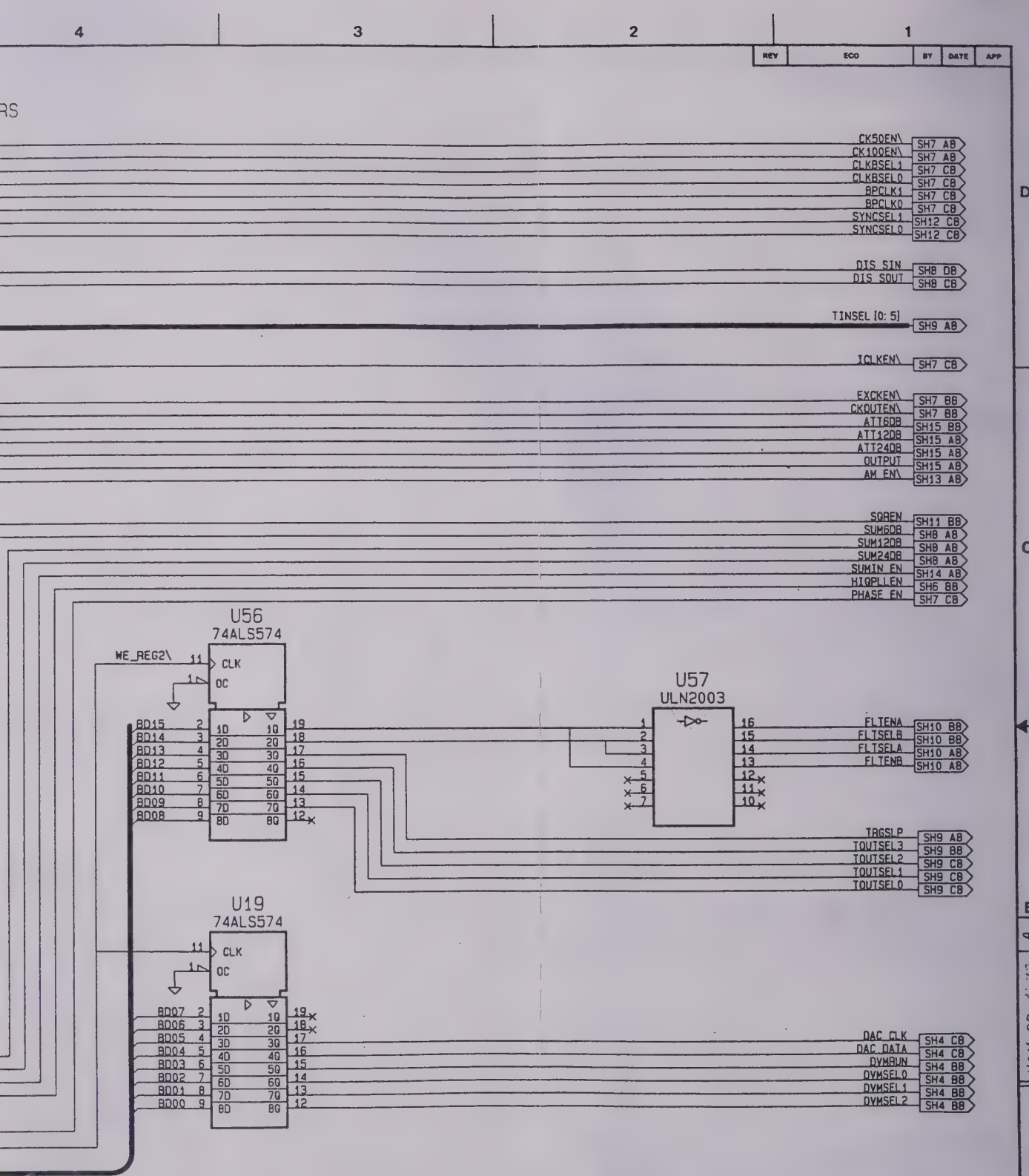


U5/F
74LS04
UNUSED GATE

NOTE UNLESS OTHERWISE SPECIFIED



POWER DISTRIBUTION CHART

F DES	U12-U15	U16, U17	U56, U19	U57
VICE	74ALS574	ULN2003	74ALS574	ULN2003
GND	10	8	10	8
+5V	20	9	20	9
PASS AP	C24-C27	C28, C29	C208, C170	C209

CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RO FIFER	DATE 5/12/92
MATERIAL	CHECKED	
	PROJ. ENGR.	
	RELEASE APPROV.	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ± .XXX ± ±	
DO NOT SCALE DRAWING		

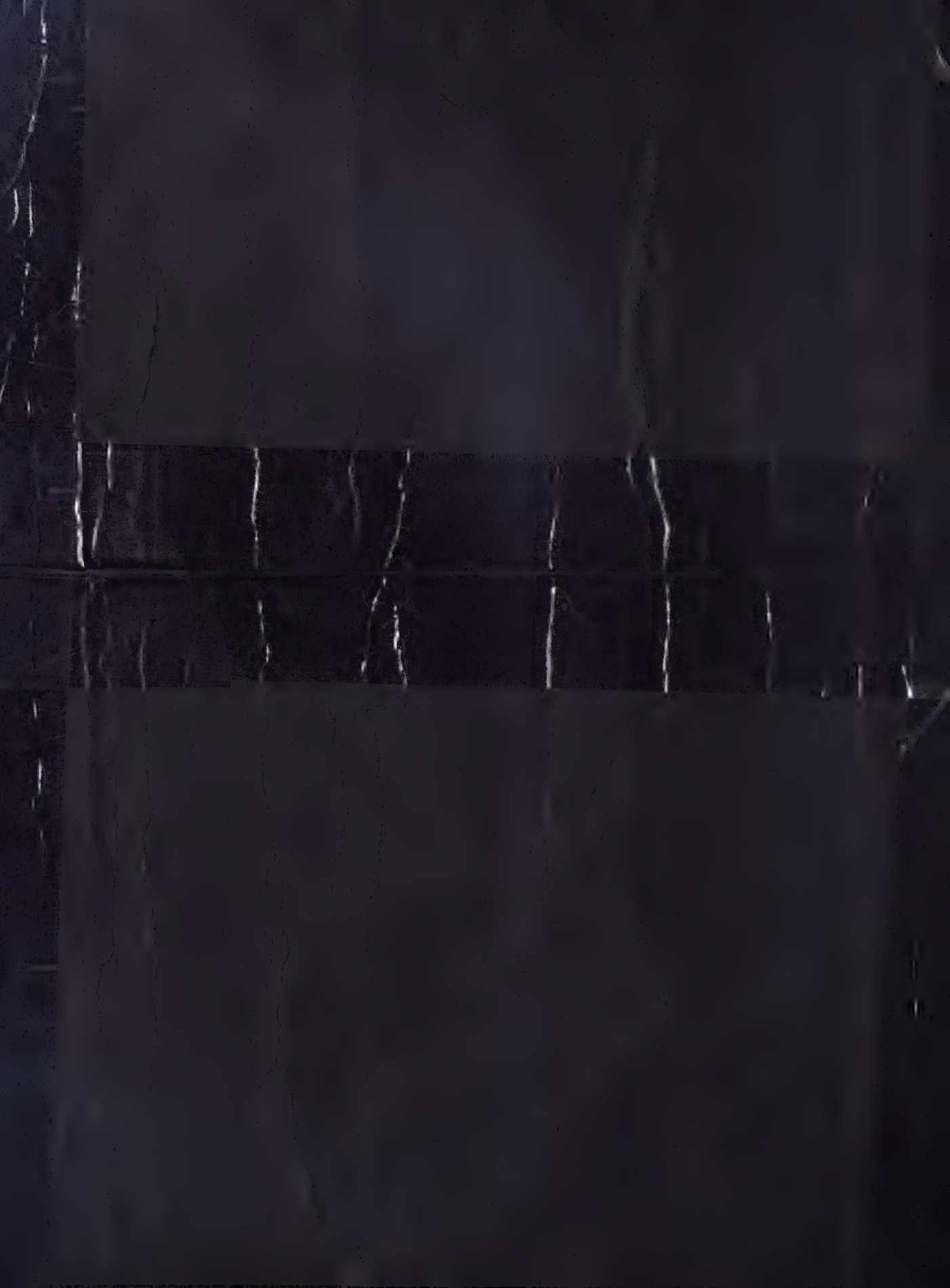
WAVETEK SAN DIEGO, CALIFORNIA

TITLE

SCHEMATIC, CHANNEL BOARD

SIZE	FSCM NO.	DWG NO.	REV
D	23338	1104-00-3679	A

SCALE MODEL 295 SHEET 3 OF 15



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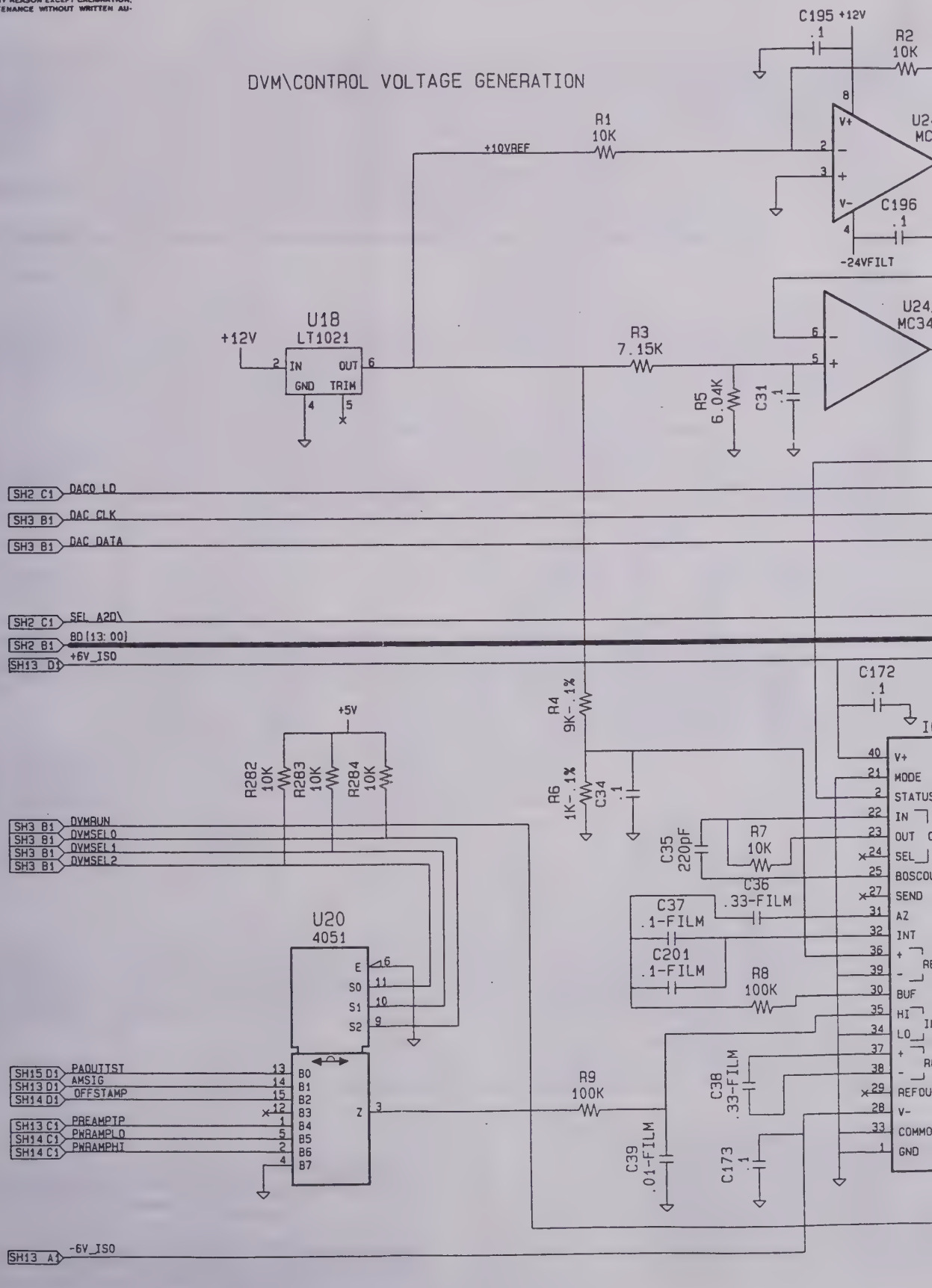
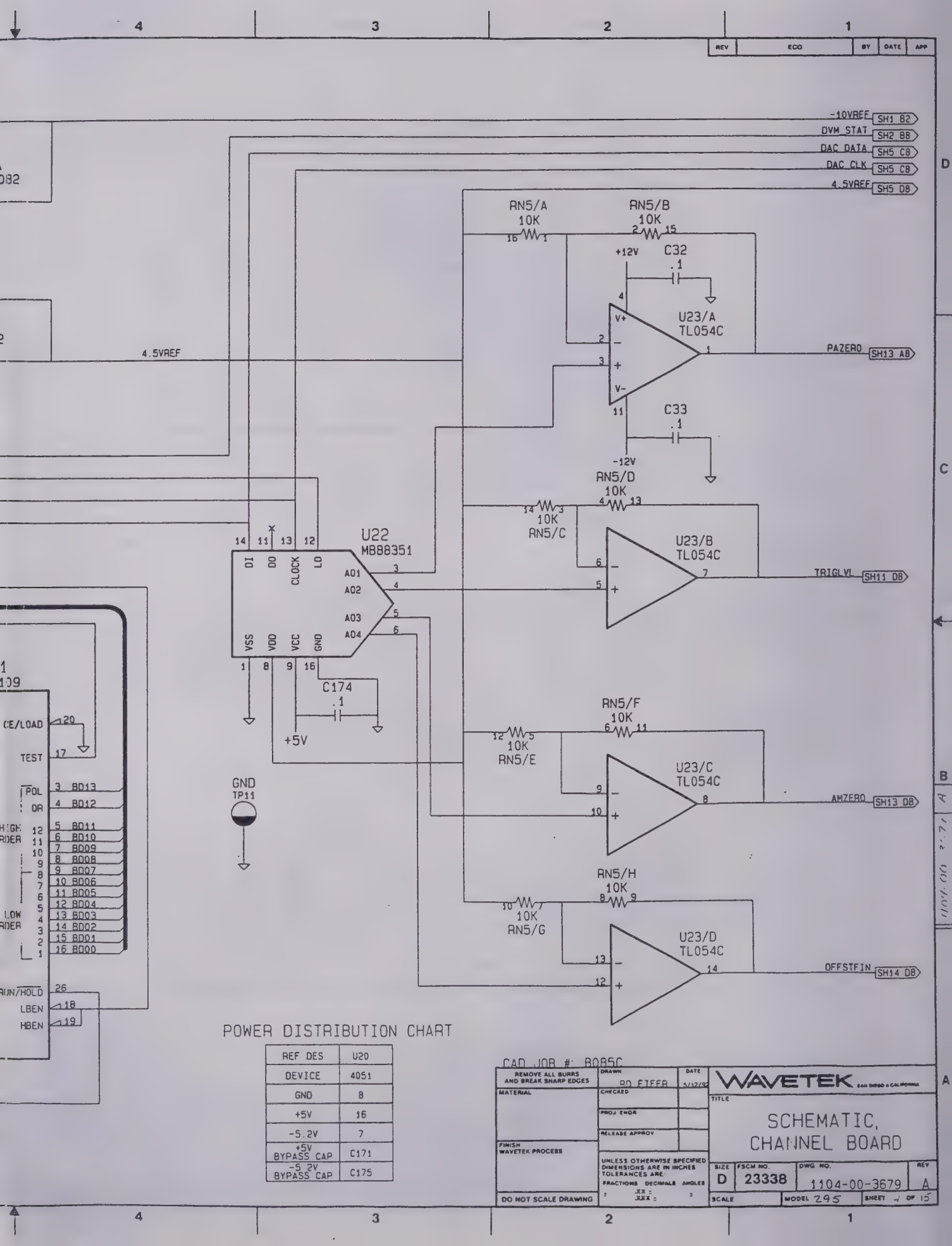
DVM\CONTROL VOLTAGE GENERATION



NOTE UNLESS OTHERWISE SPECIFIED



POWER DISTRIBUTION CHART

REF DES	U20
DEVICE	4051
GND	8
+5V	16
-5.2V	7
+5V BYPASS CAP	C171
-5.2V BYPASS CAP	C175

CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN RO FIFER 5/12/92
CHECKED
PROJ ENGR
RELEASE APPROV
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX = XXX =

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
SCHEMATIC, CHANNEL BOARD

SIZE D | FSCM NO. 23338 | DWG NO. 1104-00-3679 | REV A
SCALE | MODEL 295 | SHEET 4 OF 15

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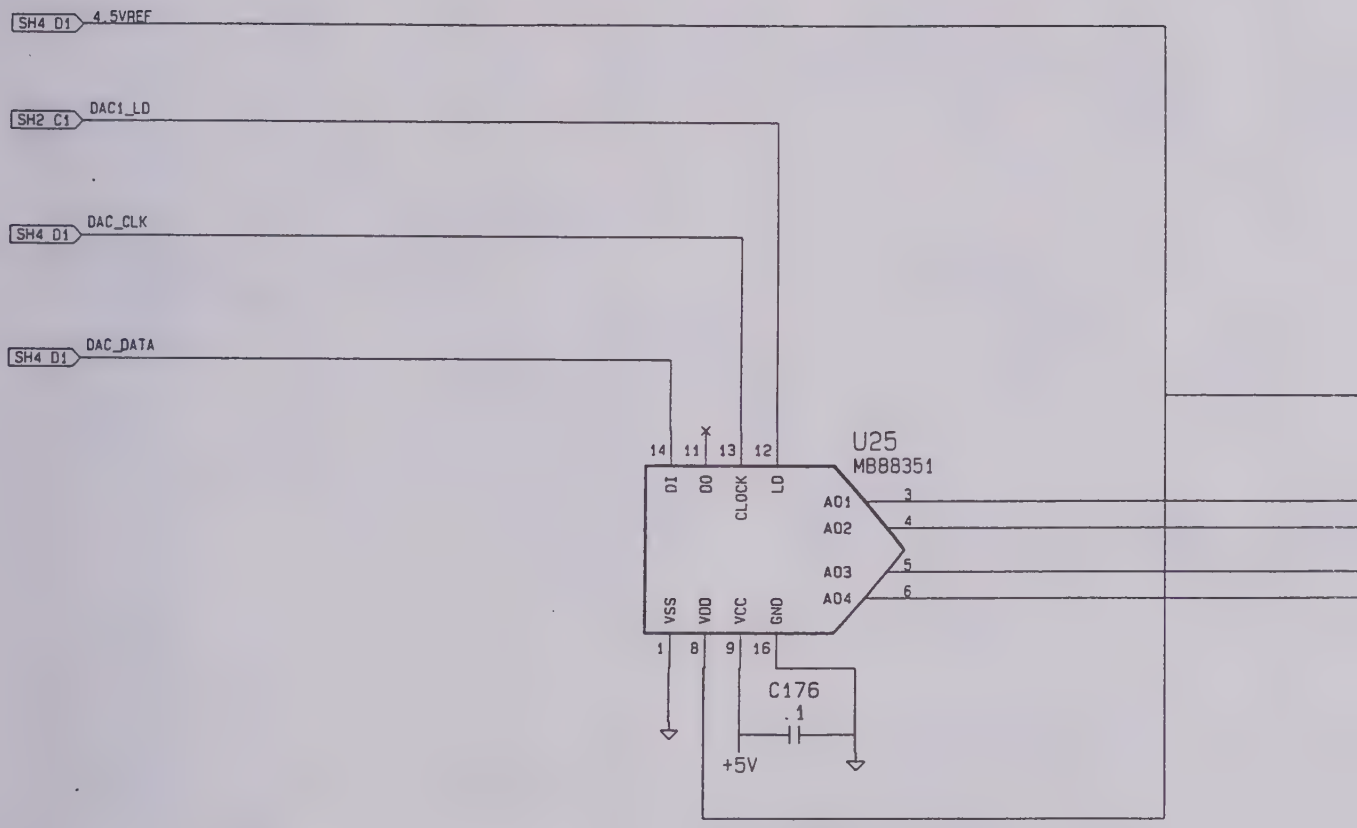
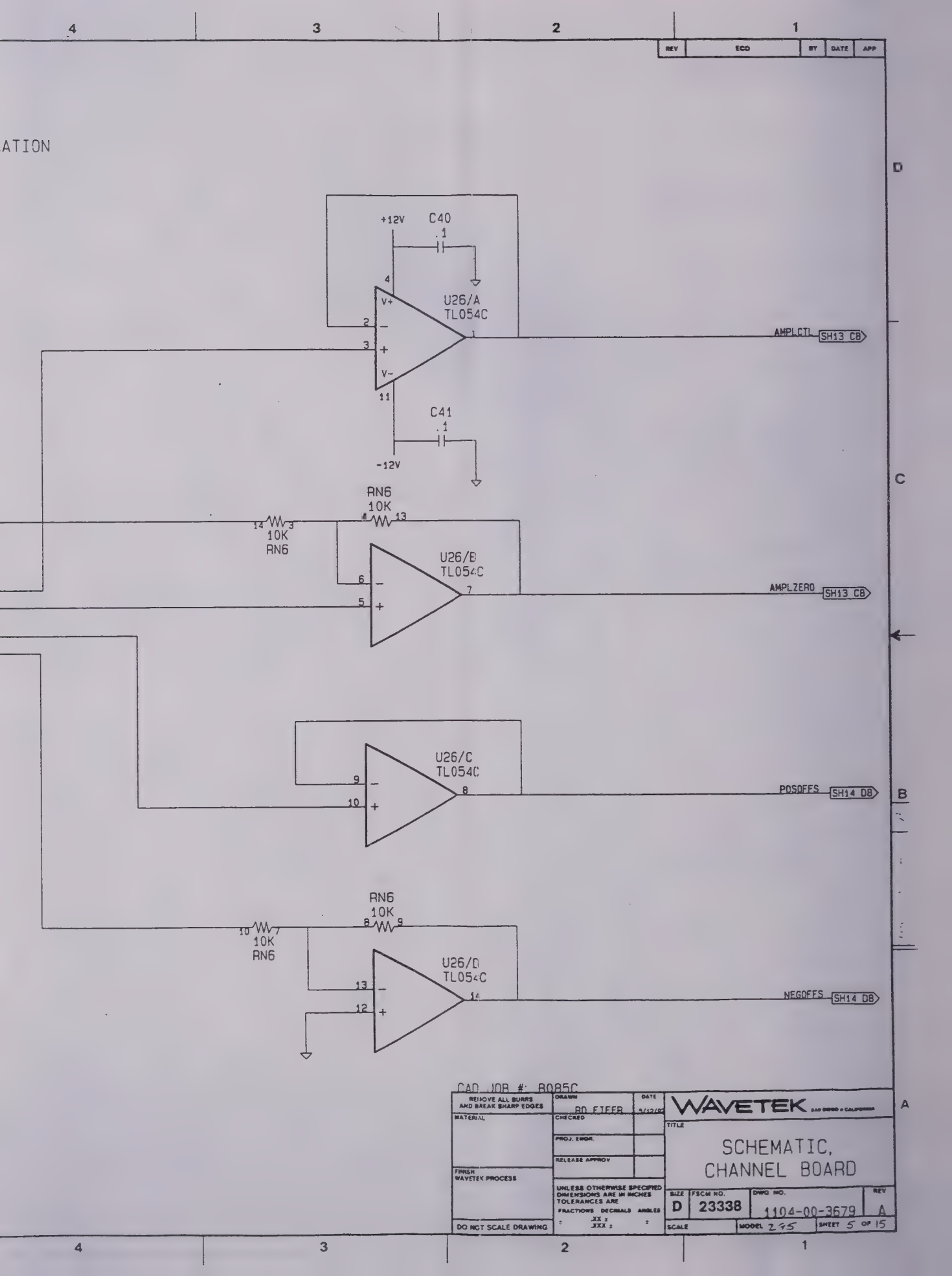
CONTROL VOLTAGE GEN



NOTE UNLESS OTHERWISE SPECIFIED


4
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+12V
C40
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U26/A
TL054C
V+
V-
AMPLCTL
SH13 C8
C41
.1
-12V
RN6
10K
10K
RN6
U26/B
TL054C
AMPLZERO
SH13 C8
U26/C
TL054C
POSOFFS
SH14 D8
RN6
10K
10K
RN6
U26/D
TL054C
NEGOFFS
SH14 D8
CAD JOB #: B085C
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH
WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN
BD FIFER
DATE
CHECKED
PROJ. ENGR.
RELEASE APPROV
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
XX ±
XXX ±
WAVETEK
TITLE
SCHEMATIC,
CHANNEL BOARD
SIZE
D
FSCM NO.
23338
DWG NO.
1104-00-3679
REV
A
SCALE
MODEL 275
SHEET 5 OF 15

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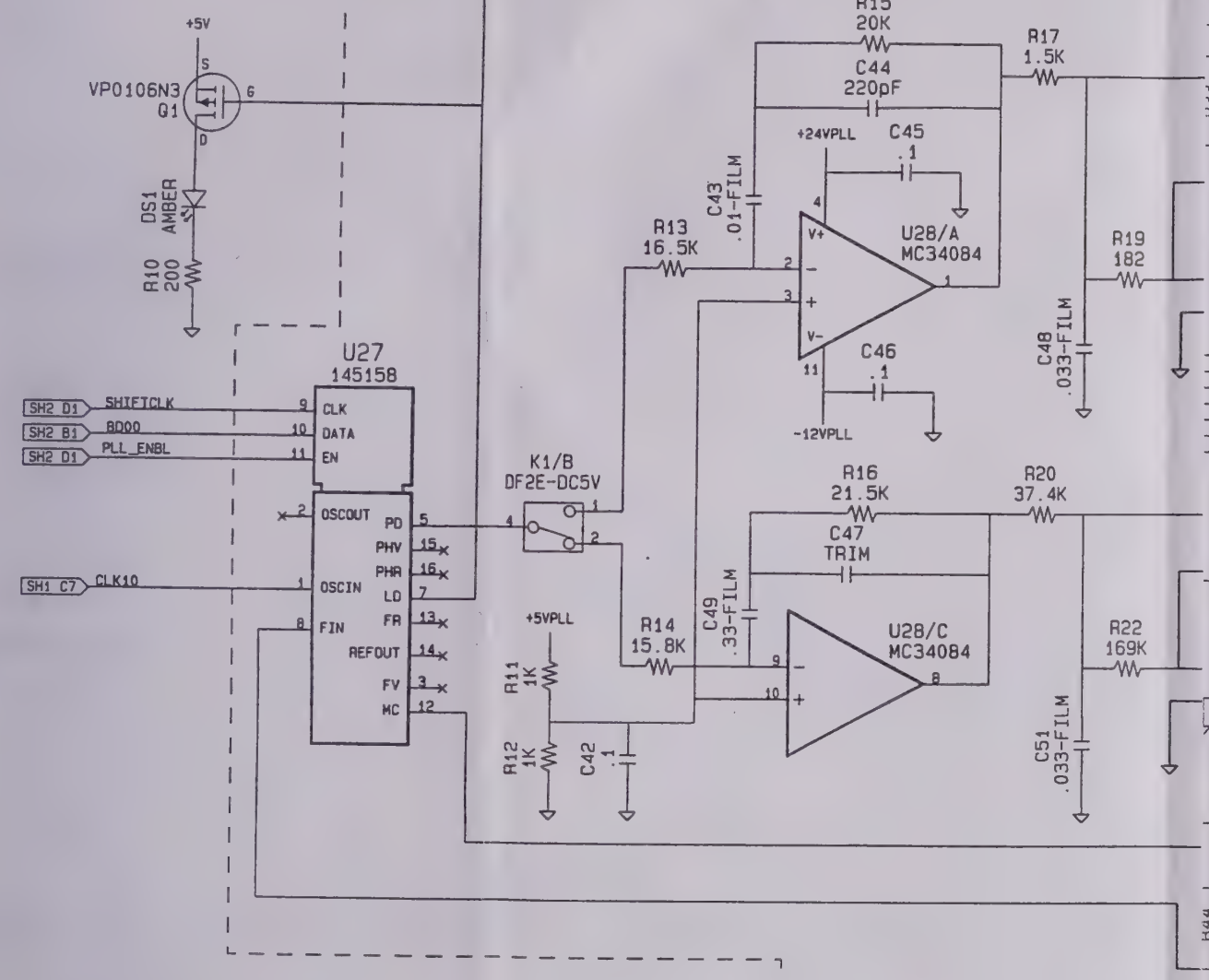
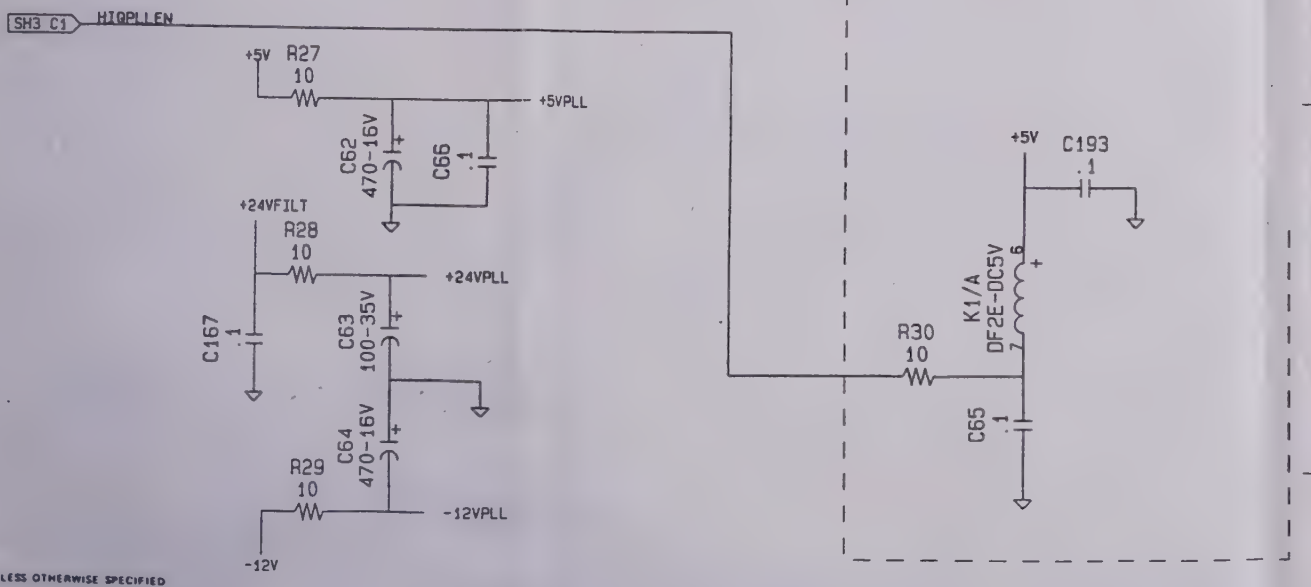
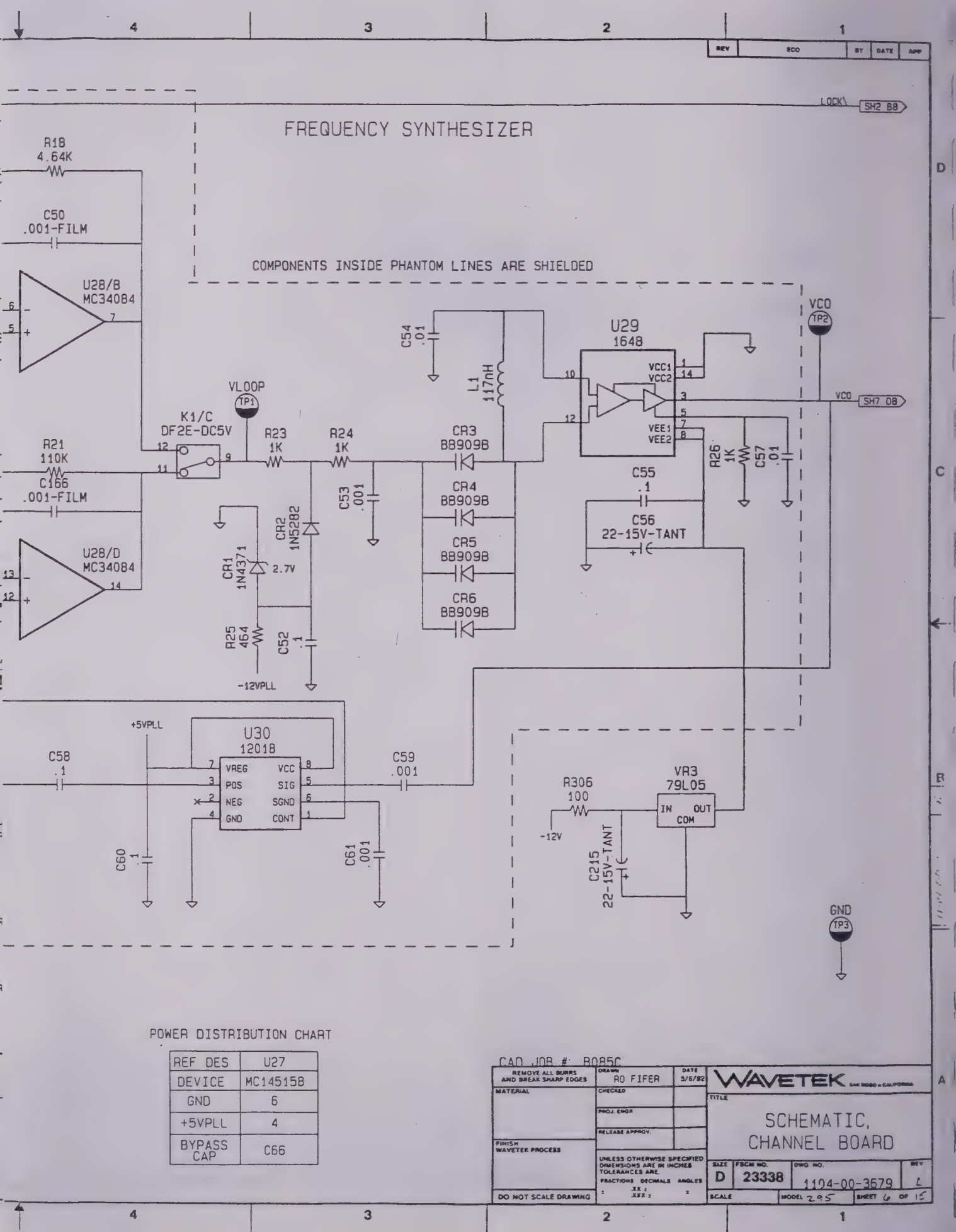




NOTE UNLESS OTHERWISE SPECIFIED



POWER DISTRIBUTION CHART

REF DES	U27
DEVICE	MC145158
GND	6
+5VPLL	4
BYPASS CAP	C66

CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: RO FIFER	DATE: 5/6/82
MATERIAL	CHECKED	
	PROJ. ENGR	
	RELEASE APPROV.	
FINISH: WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±; DECIMALS .XX ±; .XXX ±; ANGLES ±	
DO NOT SCALE DRAWING		

WAVETEK

TITLE: SCHEMATIC, CHANNEL BOARD

SIZE	FSCM NO.	DWG NO.	REV
D	23338	1104-00-3679	L

SCALE | MODEL 205 | SHEET 6 OF 15

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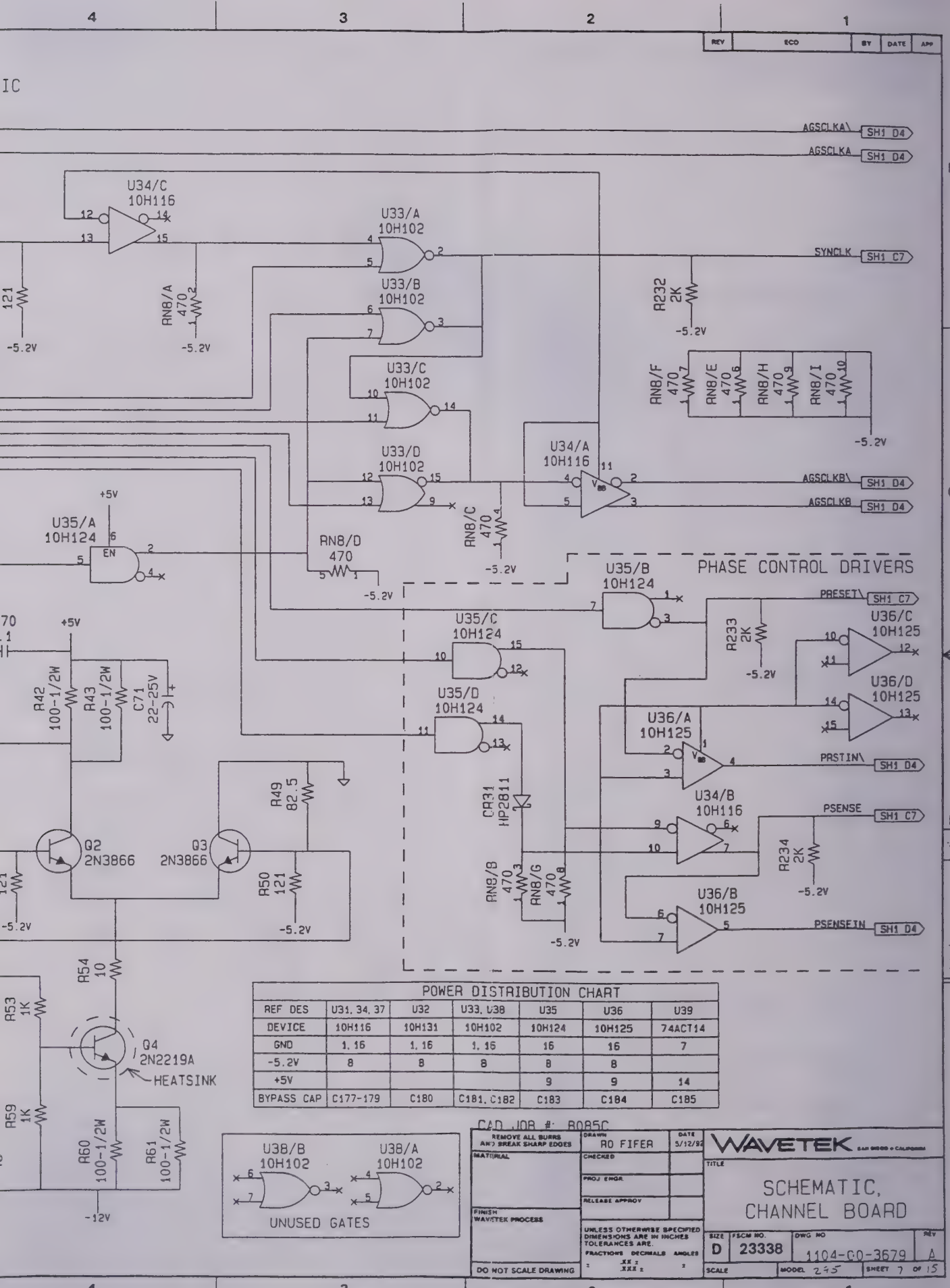
CLOCK SELECTION

U31/A 10H116
U31/B 10H116
U31/C 10H116
U32/A 10H131
U32/B 10H131
SH6 C1 VCO
SH3 C1 ICLKEN\
SH3 D1 BPCLK1
SH3 D1 BPCLK0
SH3 D1 CLKBSEL1
SH3 D1 CLKBSEL0
SH1 D4 PRSTOUT
SH1 D4 WVFMEND
SH3 C1 PHASE EN
R31 464
R32 464
-5.2V
CLOCK IN/OUT J4
C68 .1
EGND
K13/A HD1E-DC5V
R231 10
C194 .1
SH3 C1 EXCKEN\
K2/A HD1E-DC5V
R304 10
C301 .1
SH3 C1 CKOUTEN\
K2/B HD1E-DC5V
K13/B HD1E-DC5V
C69 120pF
R36 2K
CR8 HP2811
CR7 HP2811
R37 499K
+5V
U39/A 74ACT14
R40 82.5
R41 82.5
R45 121
R46 121
U37/A 10H116
U38/D 10H102
U37/C 10H116
RN9/D 470
SH3 D1 CK100EN\
SH3 D1 CK50EN\
GND TP12
U37/B 10H116
U38/C 10H102
SH1 C2 ECLCLK
SH1 C2 ECLCLK\
RN9/A 470
RN9/C 470
RN9/E 470
RN9/G 470
RN9/I 470
RN9/H 470
RN9/F 470
RN9/B 470

NOTE UNLESS OTHERWISE SPECIFIED

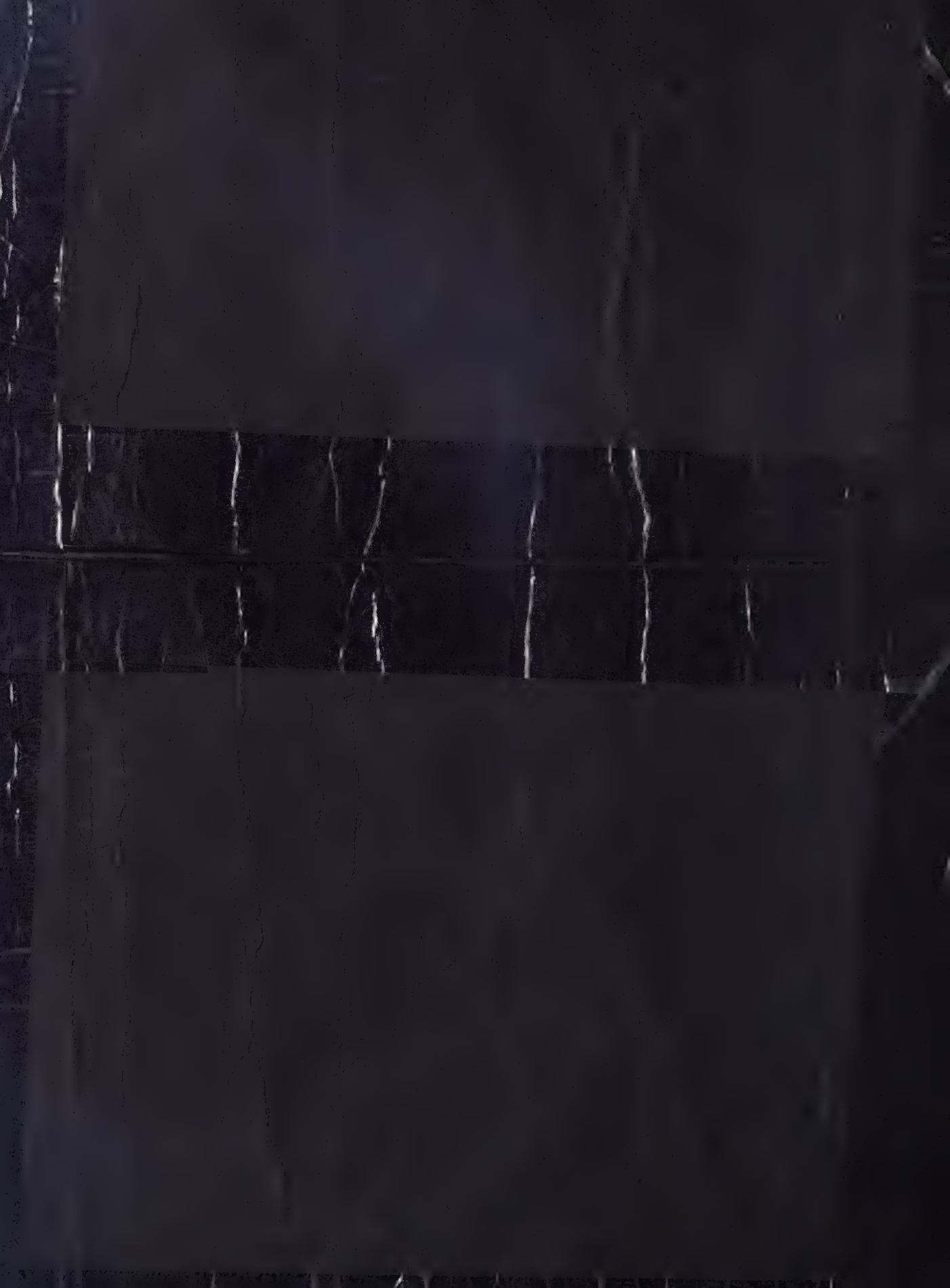


POWER DISTRIBUTION CHART

REF DES	U31, 34, 37	U32	U33, U38	U35	U36	U39
DEVICE	10H116	10H131	10H102	10H124	10H125	74ACT14
GND	1, 16	1, 16	1, 16	16	16	7
-5.2V	8	8	8	8	8	
+5V				9	9	14
BYPASS CAP	C177-179	C180	C181, C182	C183	C184	C185

C&D JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN RO FIFER 5/12/92
CHECKED
PROJ ENGR
RELEASE APPROV
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
SCHEMATIC, CHANNEL BOARD
SIZE D FSCM NO. 23338 DWG NO 1104-00-3679 REV A
SCALE MODEL 245 SHEET 7 OF 15



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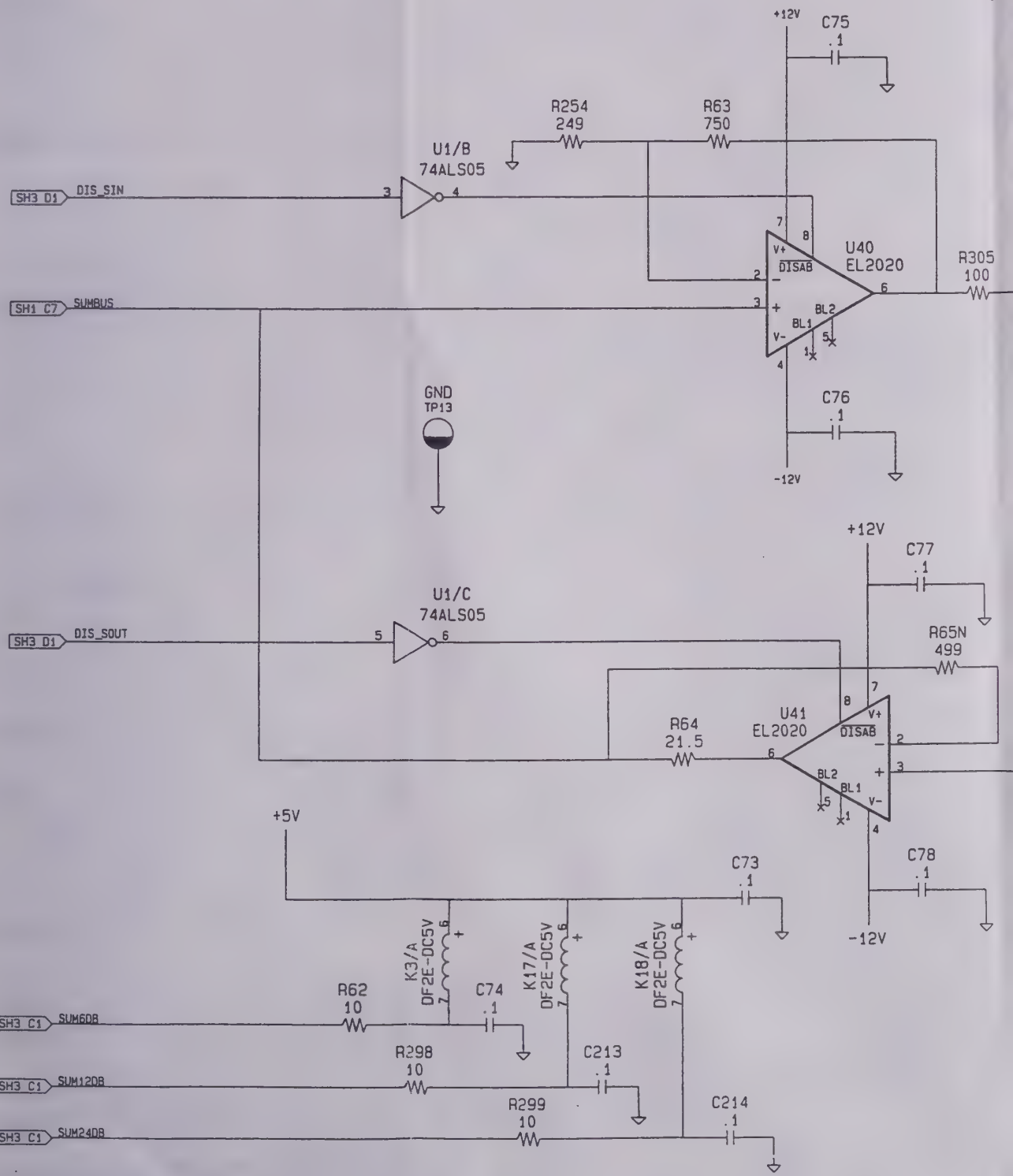
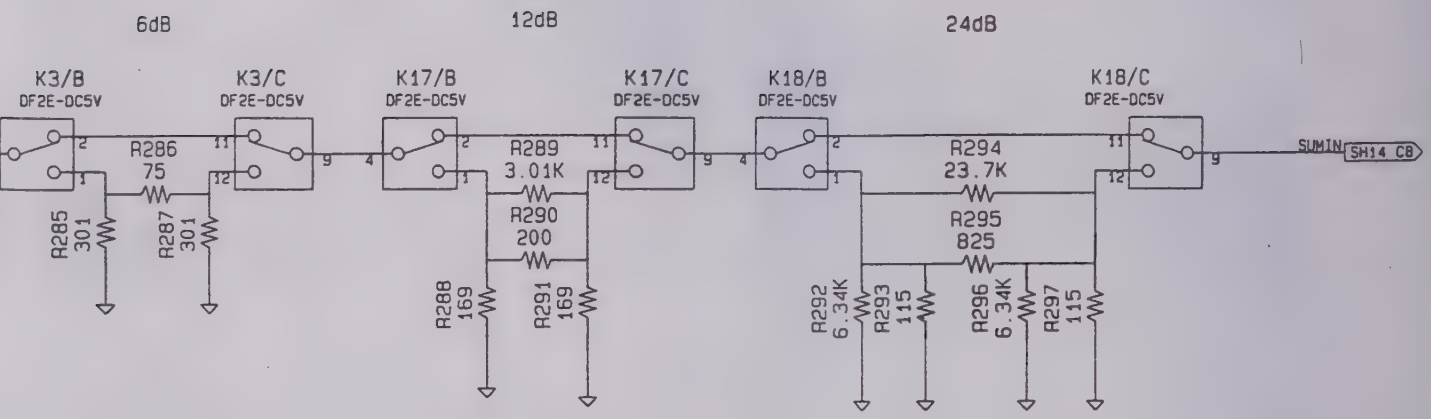
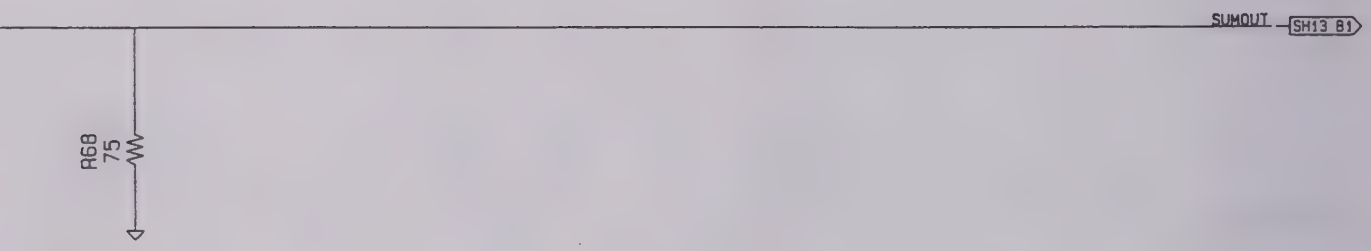


NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP

AMP





CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN DO FIFER	DATE 5/12/95	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE
	PROJ ENGR		SCHEMATIC, CHANNEL BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX ± XXX ± ±		SIZE D · FSCM NO 23338 · DWG NO 1104-00-3679 · REV A · SCALE · MODEL 145 · SHEET 2 OF 15

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INTERNAL TRIGGE

U42
DNC2016

SH2 D1 SHIFTCLK
SH2 D1 DNC_ENBL
SH2 B1 BD00
SH2 C1 RESET\
SH1 C7 CLK10

SCLK, SEN, SDIN, SLDA, ALDA, SLDB, ALDB, MRES, TMEN, CLKA, CLKB
PLD, OSCOUT, SDOUT, CYA, CYDA, CYB, CYDB

+5V

RN7
10K

SH1 D4 SMPLCLK
SH1 D4 BRSTDONE
SH1 D4 RPTDONE
SH1 D4 MARK1
SH1 D4 MARK2
SH3 B1 IOUTSEL2
SH3 B1 IOUTSEL1
SH3 B1 IOUTSEL0
SH3 B1 IOUTSEL3
SH1 C7 ITRGIN\
SH1 C7 SYSTRG\
SH1 C7 TRG0IN\
SH1 C7 TRG1IN\
SH1 C7 TRG2IN\
SH1 C6

TRIGGER INPUT
J5
C79 .1
EGND
C80 150pF
R69 2K
CR9 HP2811
CR10 HP2811
R70 499K
U39/B 74ACT14
EXITRIG\

SH3 D1 IINSEL5
SH3 D1 IINSEL4
SH3 D1 IINSEL3
SH3 D1 IINSEL2
SH3 D1 IINSEL1
SH3 D1 IINSEL0
SH3 B1 IAGSLP

POWER DISTR	
REF DES	U42
DEVICE	DNC2016
GND	14, 17
+5V	6, 18
BYPASS CAP	C81

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP

R GENERATOR

GND
TP14

INPUT/OUTPUT TRIGGER SELECTION

U43
PAL16R4

U44
PAL16L8

CTRIG\ → SH1 C6
ECTRIG\ → SH1 C7
ITRGOUT\ → SH1 C6
TRIGA → SH1 C4
TRIGB → SH1 C4
TRGMNTR → SH2 B8

UTION CHART	
U43	U44
PAL16R4	PAL16L8
10	10
20	20
C82	C83

CAD JOB #: B085C

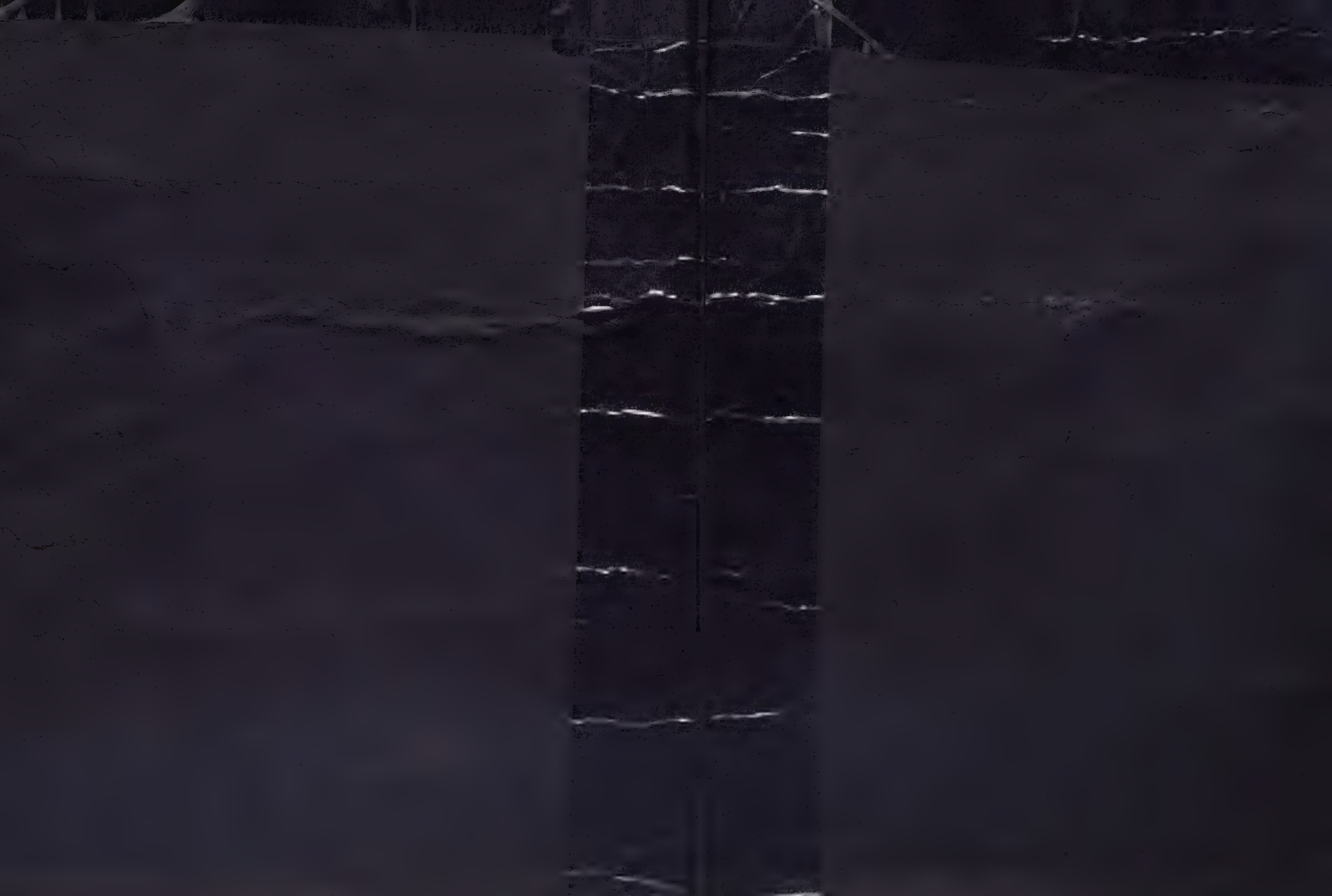
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN AD FIFER	DATE 5/6/82
MATERIAL	CHECKED	
	PROJ ENGR	
FINISH WAVETEK PROCESS	RELEASE APPROV.	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± ±	

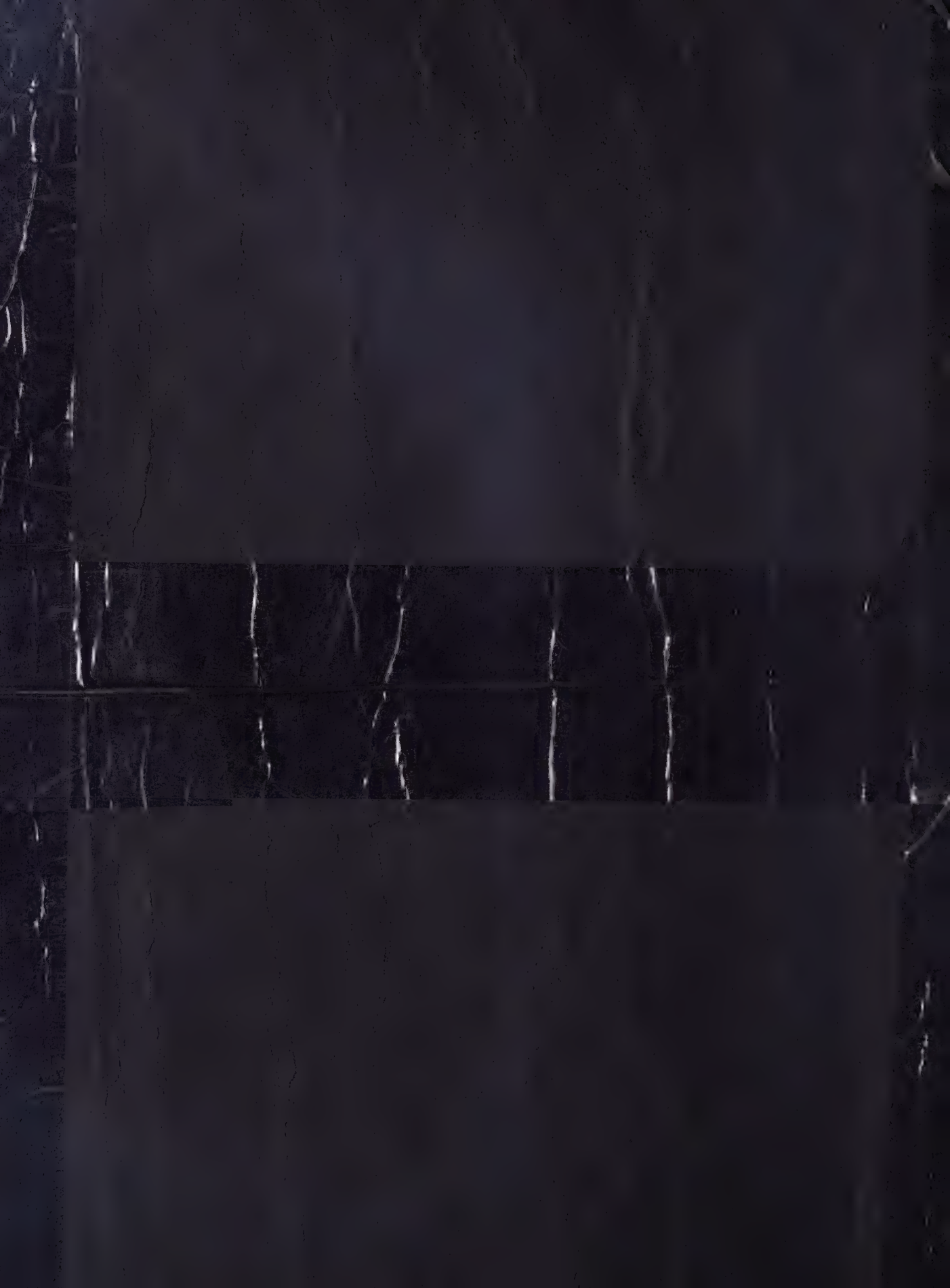
WAVETEK SAN DIEGO, CALIFORNIA

TITLE
SCHEMATIC,
CHANNEL BOARD

SIZE	FSCM NO.	DWG. NO.	REV
D	23338	1104-00-3679	A

SCALE | MODEL 295 | SHEET 9 OF 15





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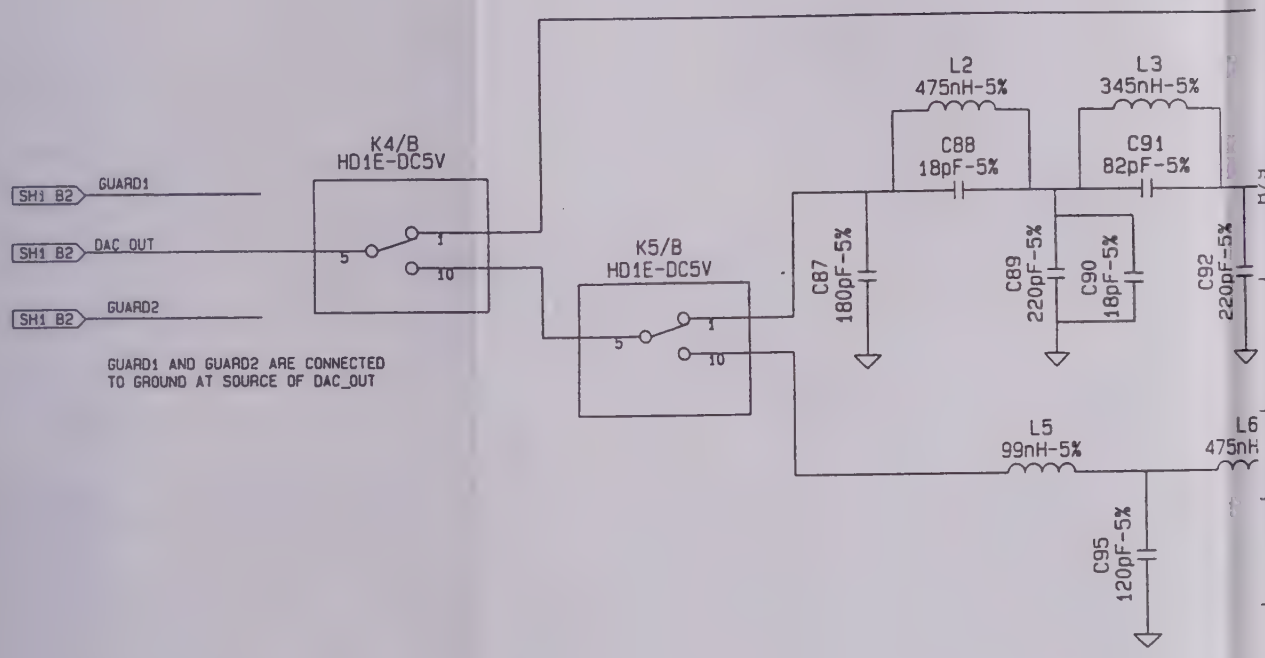
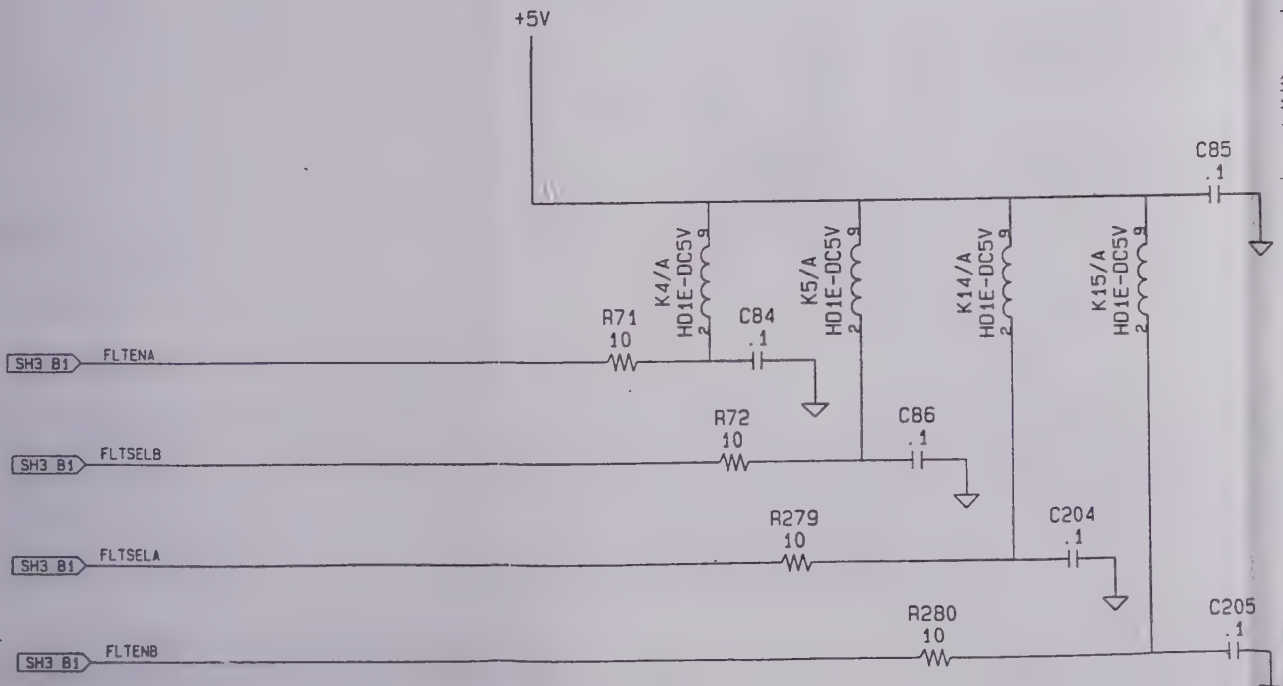
WAVEFORM

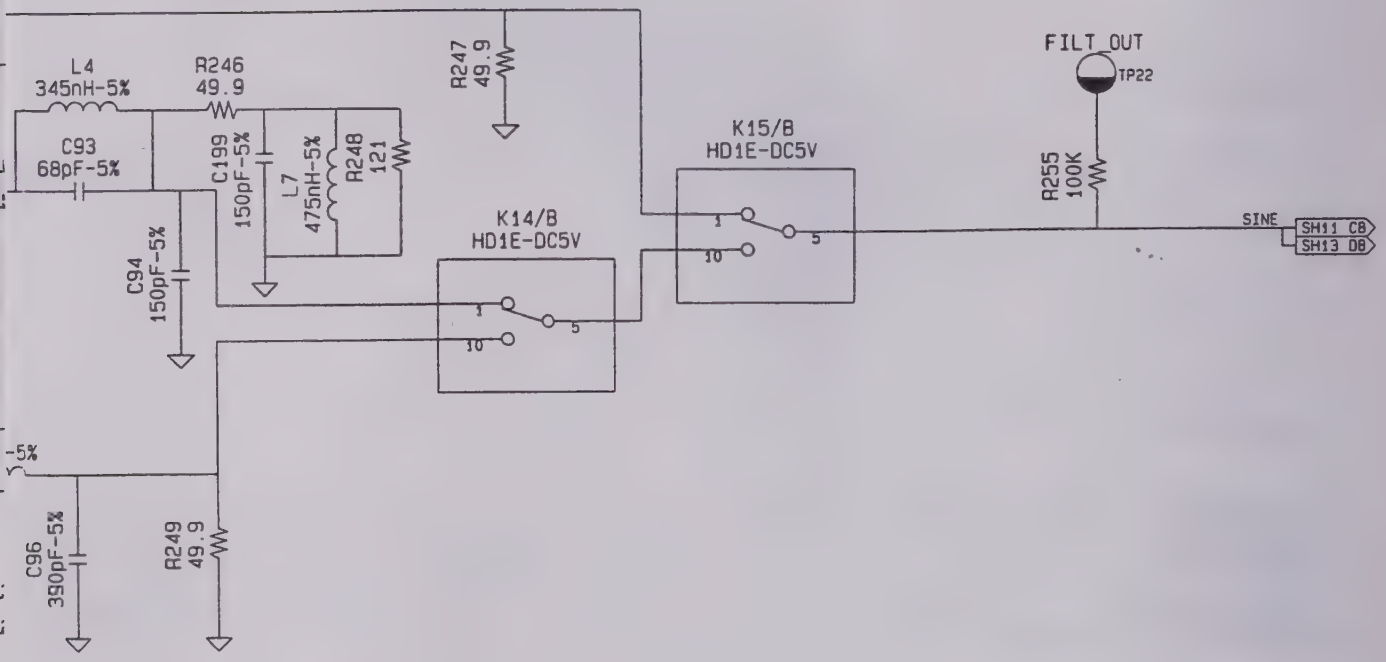




NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP

FILTERS



CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: RO FIFER	DATE: 5/6/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: SCHEMATIC, CHANNEL BOARD
	PROJ. ENGR.		
FINISH: WAVETEK PROCESS	RELEASE APPROV.		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±		SIZE: D; FSCM NO.: 23338; DWG NO.: 1104-00-3679; REV: A; SCALE; MODEL: 265; SHEET 10 OF 15

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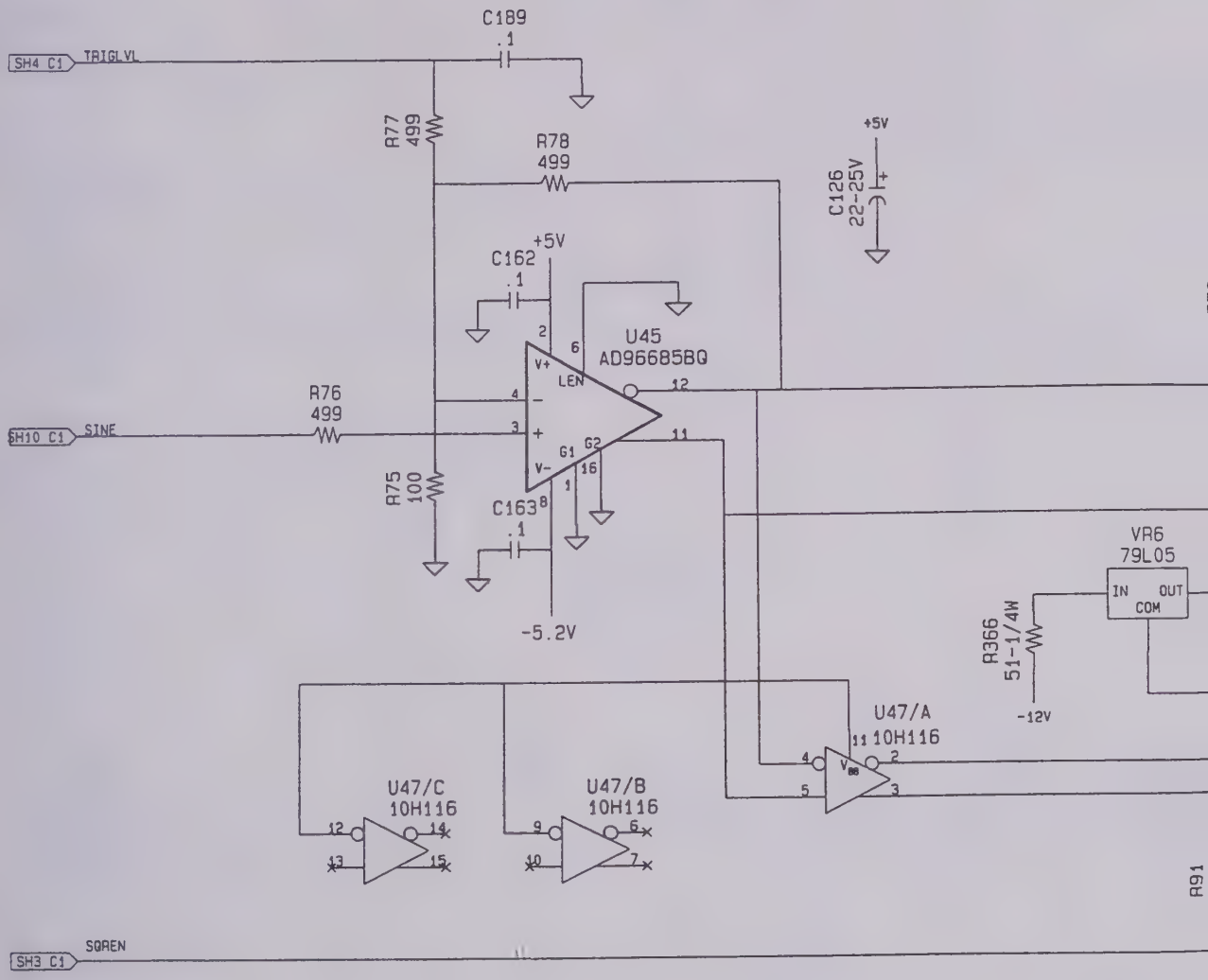
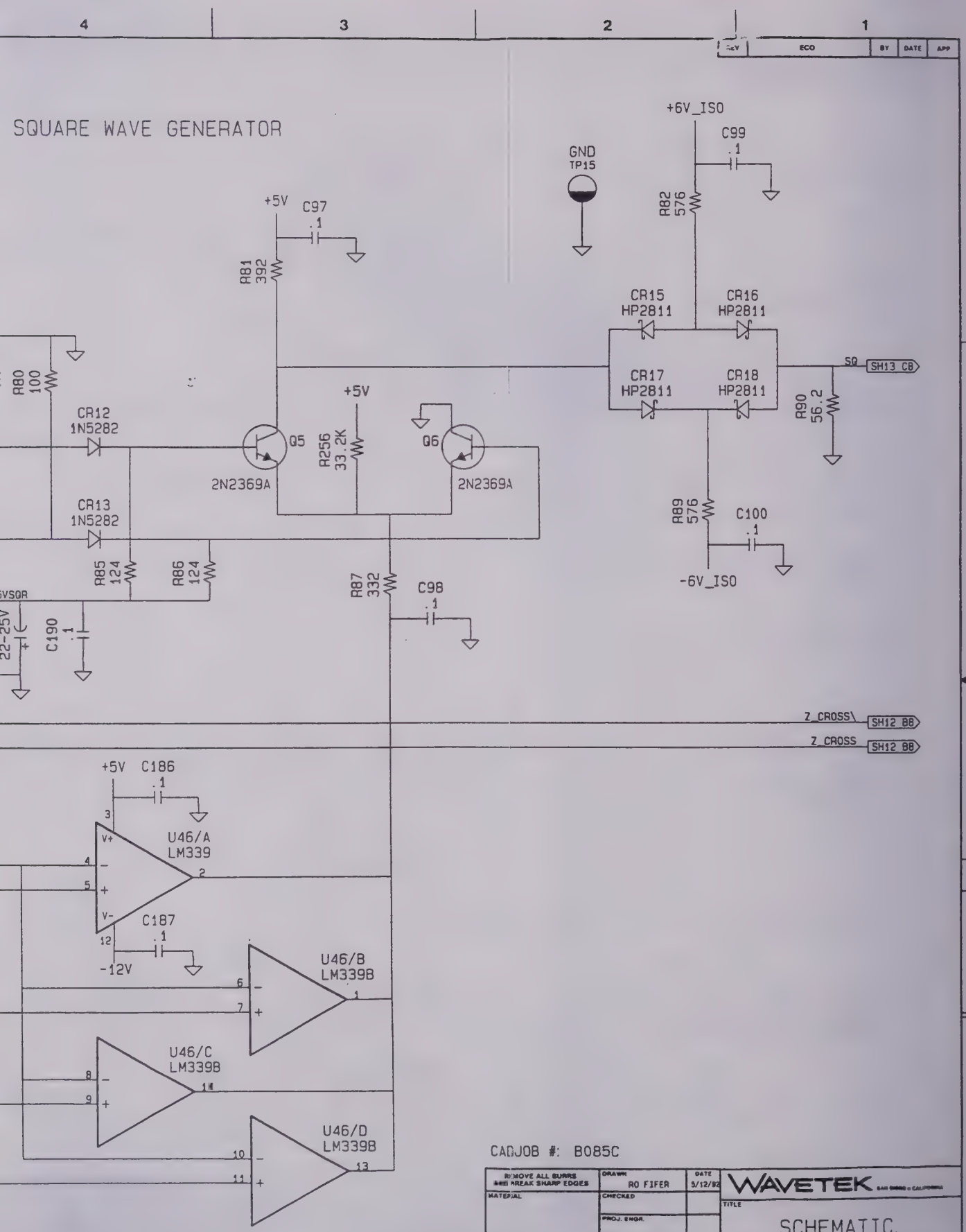


POWER DISTRIBUTION	
REF DES	U47
DEVICE	10H116
GND	1, 16
-5.2V	8
BYPASS CAP	C200

NOTE UNLESS OTHERWISE SPECIFIED



CADJOB #: B085C

REMOVE ALL BURRS & BREAK SHARP EDGES	DRAWN: RO FIFER	DATE: 5/12/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: SCHEMATIC, CHANNEL BOARD
FINISH: WAVETEK PROCESS	PROJ. ENGR.		
DO NOT SCALE DRAWING	RELEASE APPROV.		SIZE: D · FSCM NO.: 23338 · DWG NO.: 1104-00-3679 · REV: A
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± · DECIMALS .XX ± .XXX ± · ANGLES ±		SCALE · MODEL: 295 · SHEET 11 OF 15

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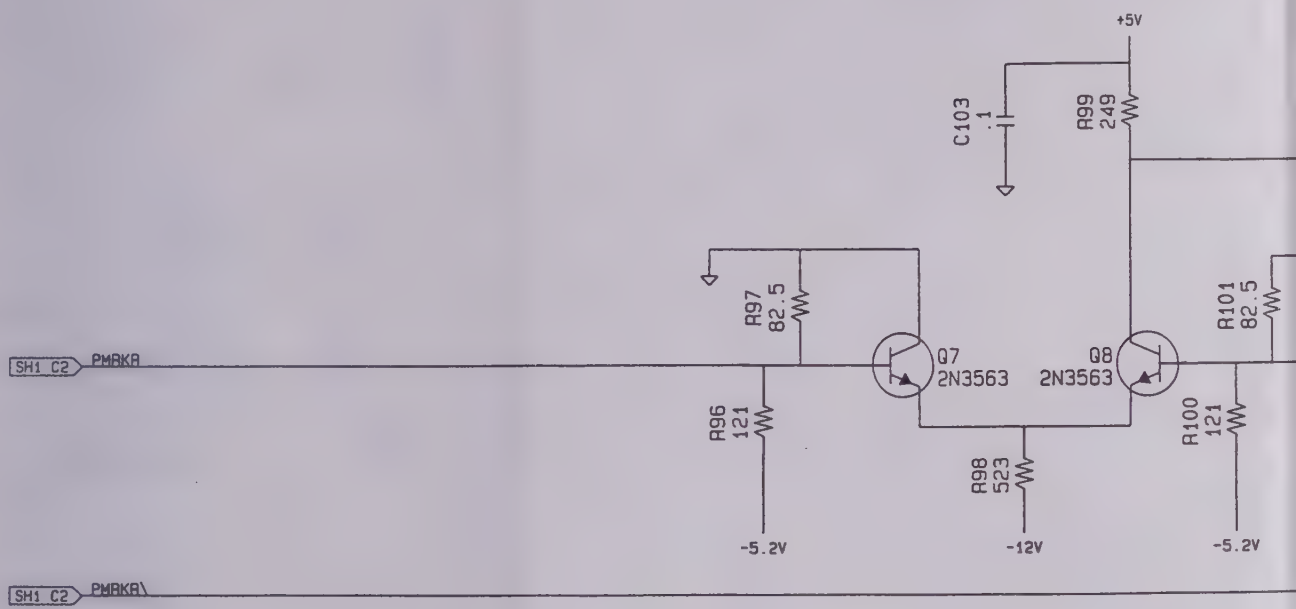
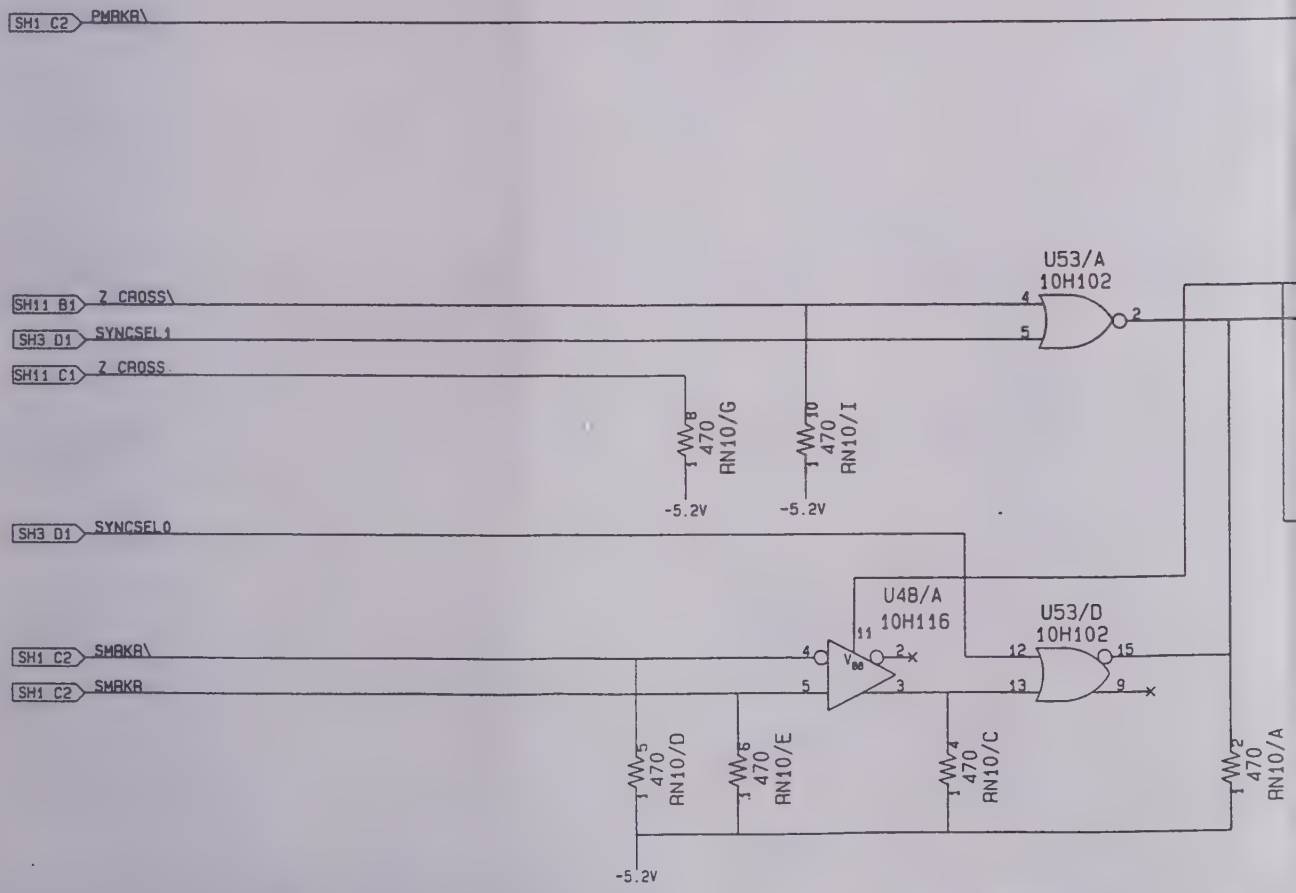
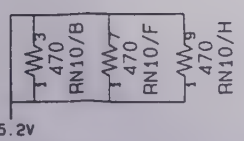
SYNC OUTPUT DRIVERS

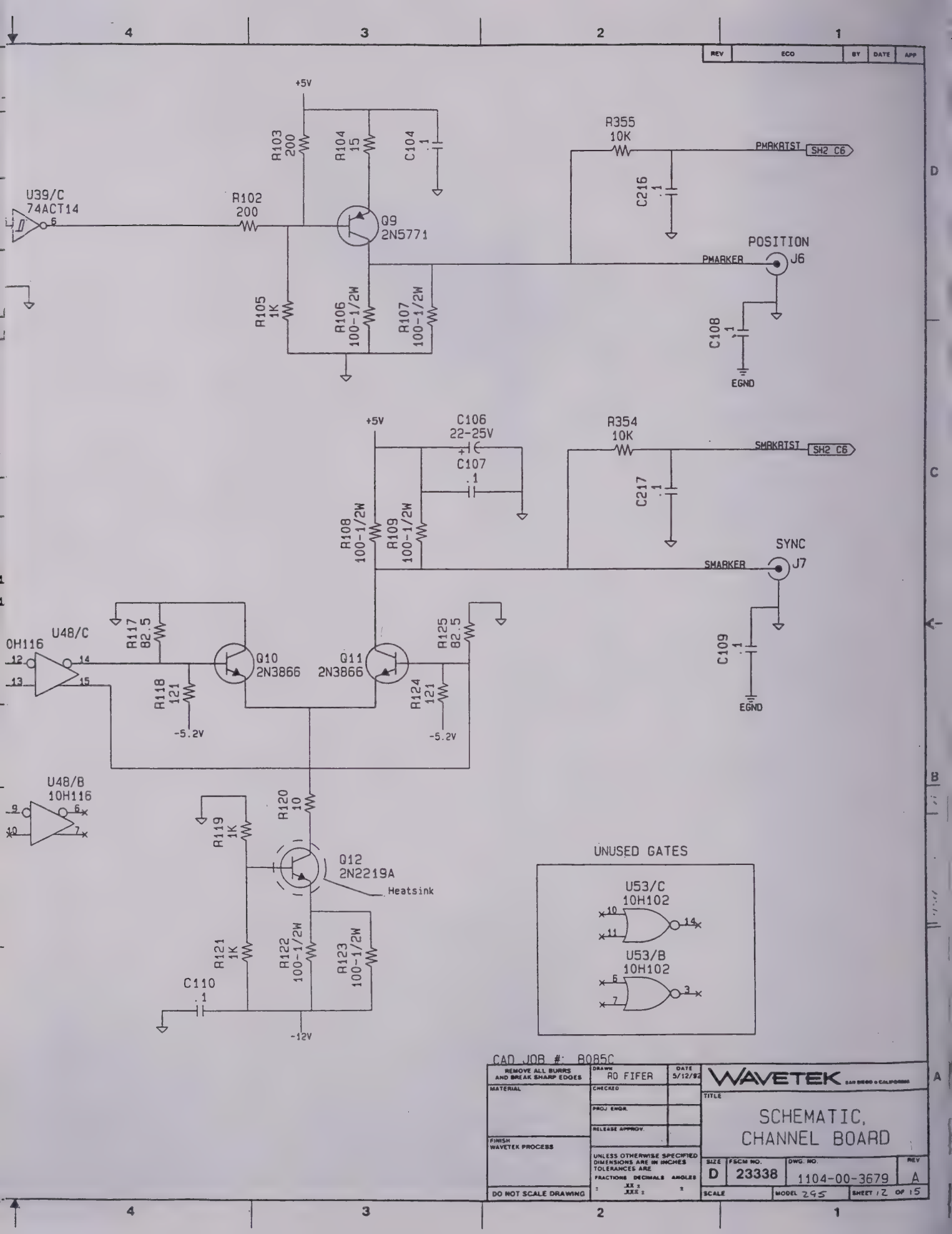






POWER DISTRUBUTION CHART		
REF DES	U53	U48
DEVICE	10H102	10H116
GND	1, 16	1, 16
-5.2V	8	8
BYPASS CAPS	C191	C192

NOTE UNLESS OTHERWISE SPECIFIED



CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RO FIFER	DATE 5/12/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: SCHEMATIC, CHANNEL BOARD
	PROJ. ENGR.		
FINISH WAVETEK PROCESS	RELEASE APPROV.		SIZE D · FSCM NO. 23338 · DWG. NO. 1104-00-3679 · REV A
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ± .XXX ± ±		SCALE · MODEL 295 · SHEET 12 OF 15

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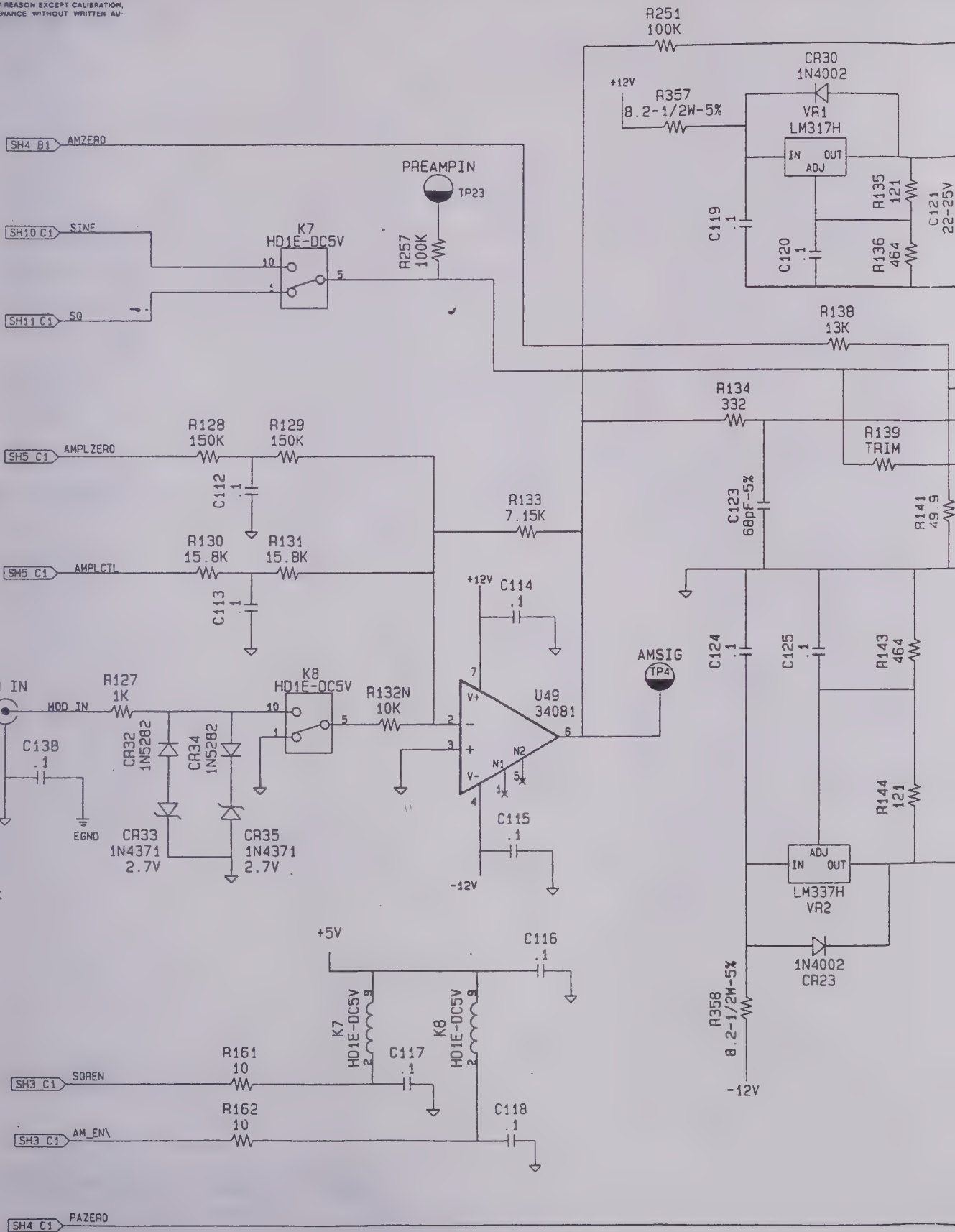
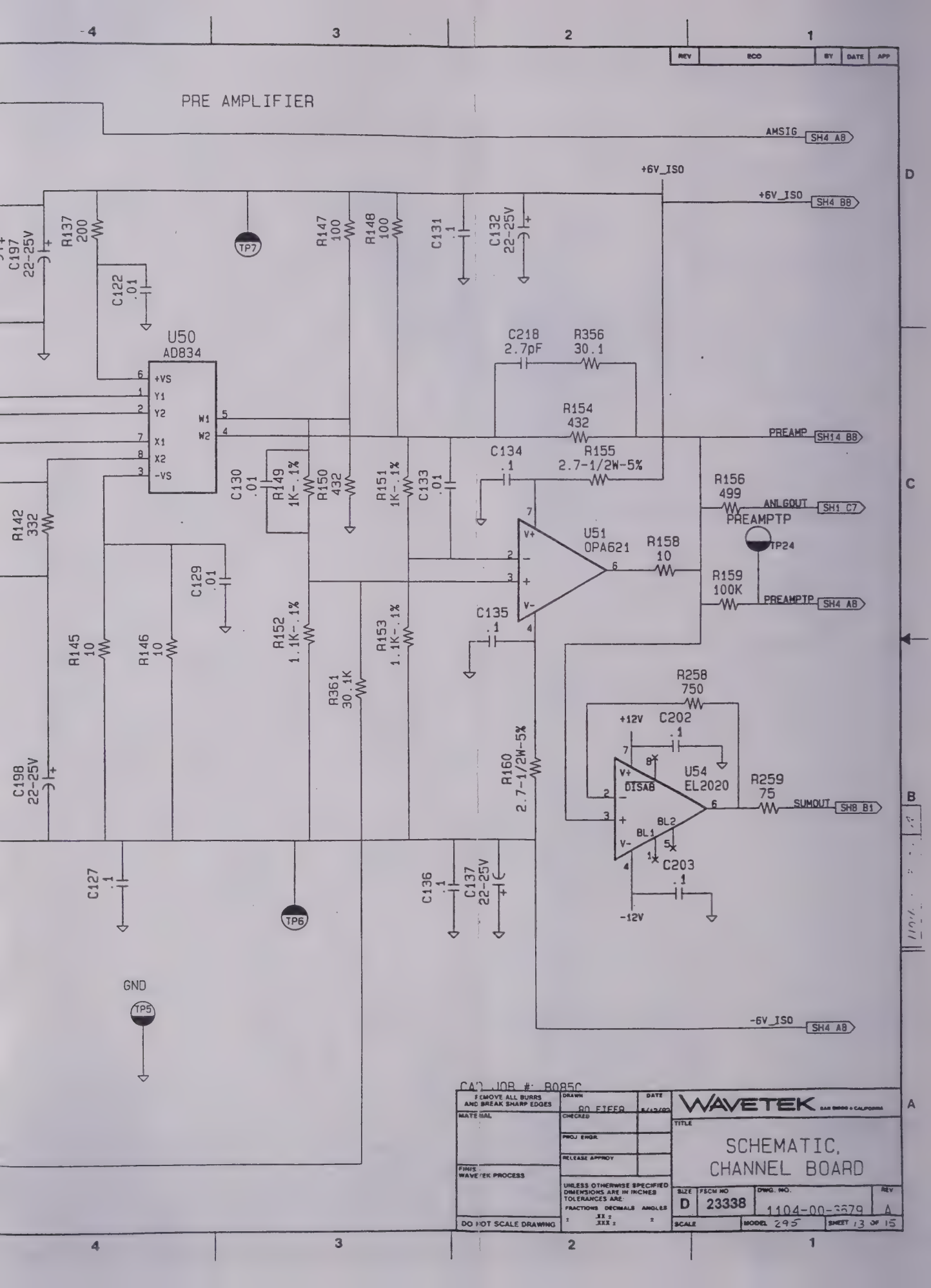


NOTE UNLESS OTHERWISE SPECIFIED


PRE AMPLIFIER
AMSIG
SH4 A8
+6V_ISO
SH4 B8
U50
AD834
+VS
Y1
Y2
X1
X2
-VS
W1
W2
R137 200
C122 .01
C197 22-25V
R147 100
R148 100
C131 .1
C132 22-25V
TP7
C218 2.7pF
R356 30.1
R154 432
PREAMP
SH14 B8
C134 .1
R155 2.7-1/2W-5%
C130 .01
R149 1K-.1%
R150 432
R151 1K-.1%
C133 .01
R156 499
ANLGOUT
SH1 C7
PREAMPTP
TP24
U51
OPA621
R158 10
R159 100K
PREAMPIP
SH4 A8
C135 .1
R142 332
C129 .01
R145 10
R146 10
R152 1.1K-.1%
R153 1.1K-.1%
R361 30.1K
R160 2.7-1/2W-5%
R258 750
+12V
C202 .1
U54
EL2020
DISAB
BL1
BL2
R259 75
SUMOUT
SH8 B1
C203 .1
-12V
C198 22-25V
C127 .1
C136 .1
C137 22-25V
TP6
GND
TP5
-6V_ISO
SH4 A8
CAD JOB #: B085C
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN
CHECKED
PROJ ENGR
RELEASE APPROV
DATE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES
WAVETEK
TITLE
SCHEMATIC, CHANNEL BOARD
SIZE D
FSCM NO 23338
DWG. NO. 1104-00-3679
REV A
SCALE
MODEL 295
SHEET 13 OF 15

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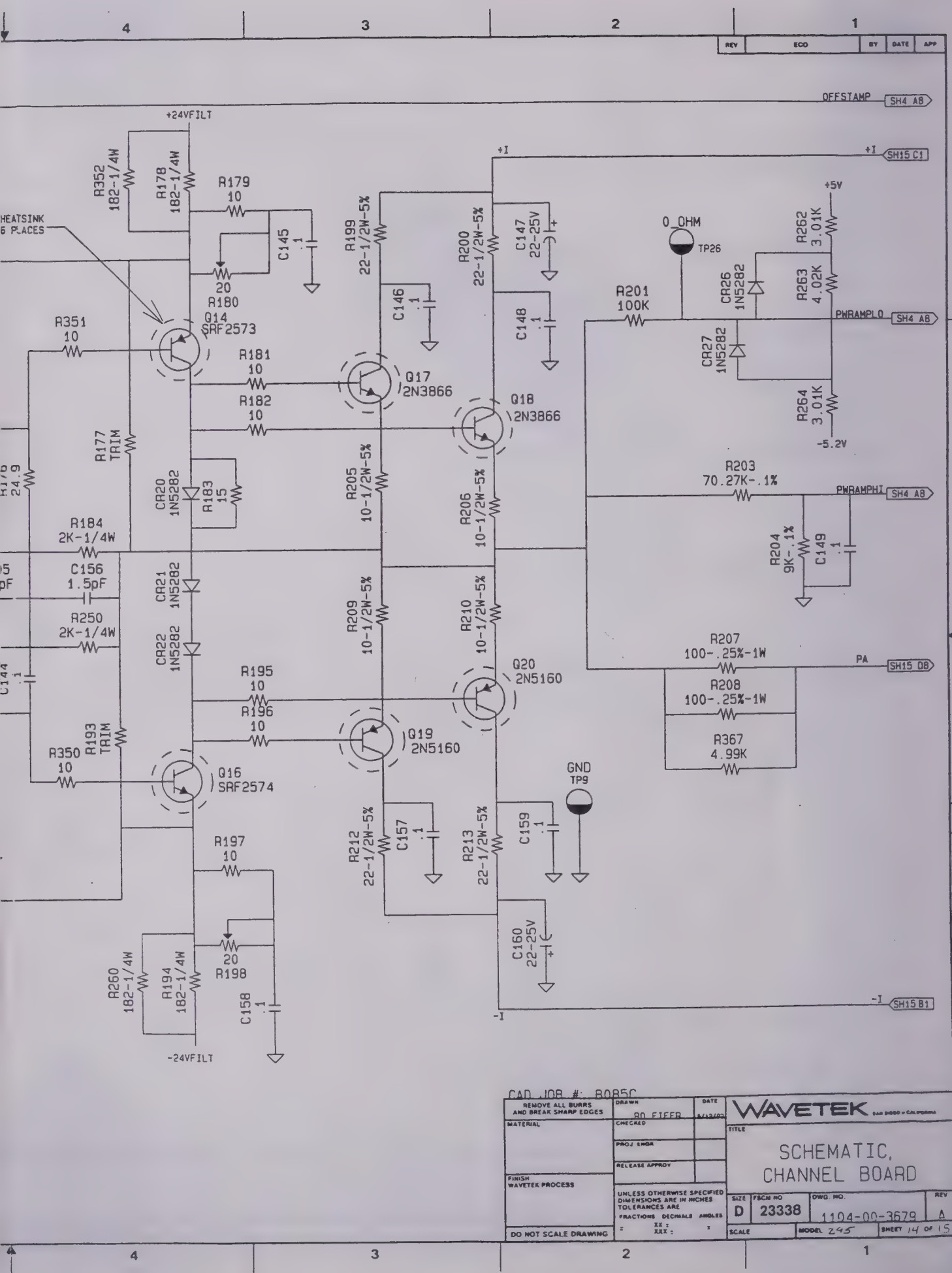
OUTPUT AMP

SH5 A1 NEGOFFS
SH4 A1 OFFSTFIN
SH5 B1 POSOFFS
SH8 C1 SUMIN
SH13 C1 PREAMP
SH3 C1 SUMIN EN

R163 7.32K
R164 100K
R165 7.32K
R166 10K
R167 100K
R168 402
R169 200
R170 100
R171 100
R172 1K
R173 2.21K
R174 24.9K
R175 1K-1/2W-5%
R185 1K
R186 1K
R187 1K-1/2W-5%
R188 2.49K
R191 10
R228 402
R229 24.9K
R300 100K
R362 100K
R363 100
C139 .1
C140 .1
C141 .1
C142 .1
C143 .1
C150 .1
C151 .1
C154 .1
C165 .1
C210 .1
C211 .1
C302 82pF
C303 .01
C304 .01
C169 22-25V
C168 22-25V
U58/B 34082P
U58/A 34082P
U55 EL2020
K9 HD1E-DC5V
K9/A HD1E-DC5V
CR24 1N4740A
CR25 1N4740A
Q13 2N3563
Q15 2N5771
TP25 DC_STABILITY
+12V
-12V
+5V
+24VFILT
-24VFILT
DISAB
BL1
BL2

NOTE UNLESS OTHERWISE SPECIFIED



CAD JOB #: B085C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RD FIFER 4/13/00	WAVETEK SAN DIEGO, CALIFORNIA	
MATERIAL	CHECKED	TITLE	SCHEMATIC, CHANNEL BOARD
	PROJ ENGR		
FINISH WAVETEK PROCESS	RELEASE APPROV		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES XX ± XXX ±	SIZE D / FSCM NO 23338 / DWG. NO. 1104-00-3679 / REV A	
		SCALE	MODEL 245 SHEET 14 OF 15

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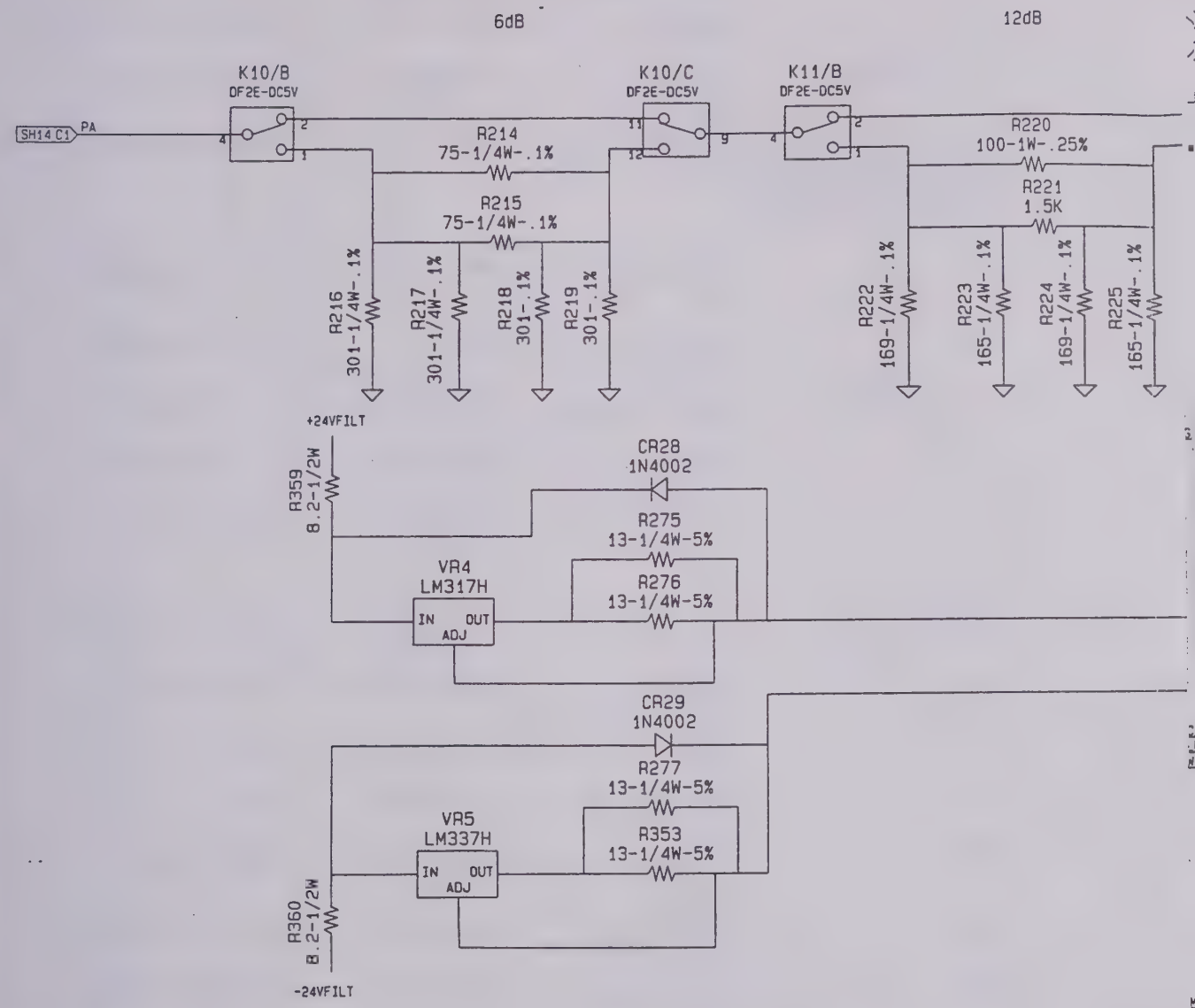
OUTPUT ATTE-



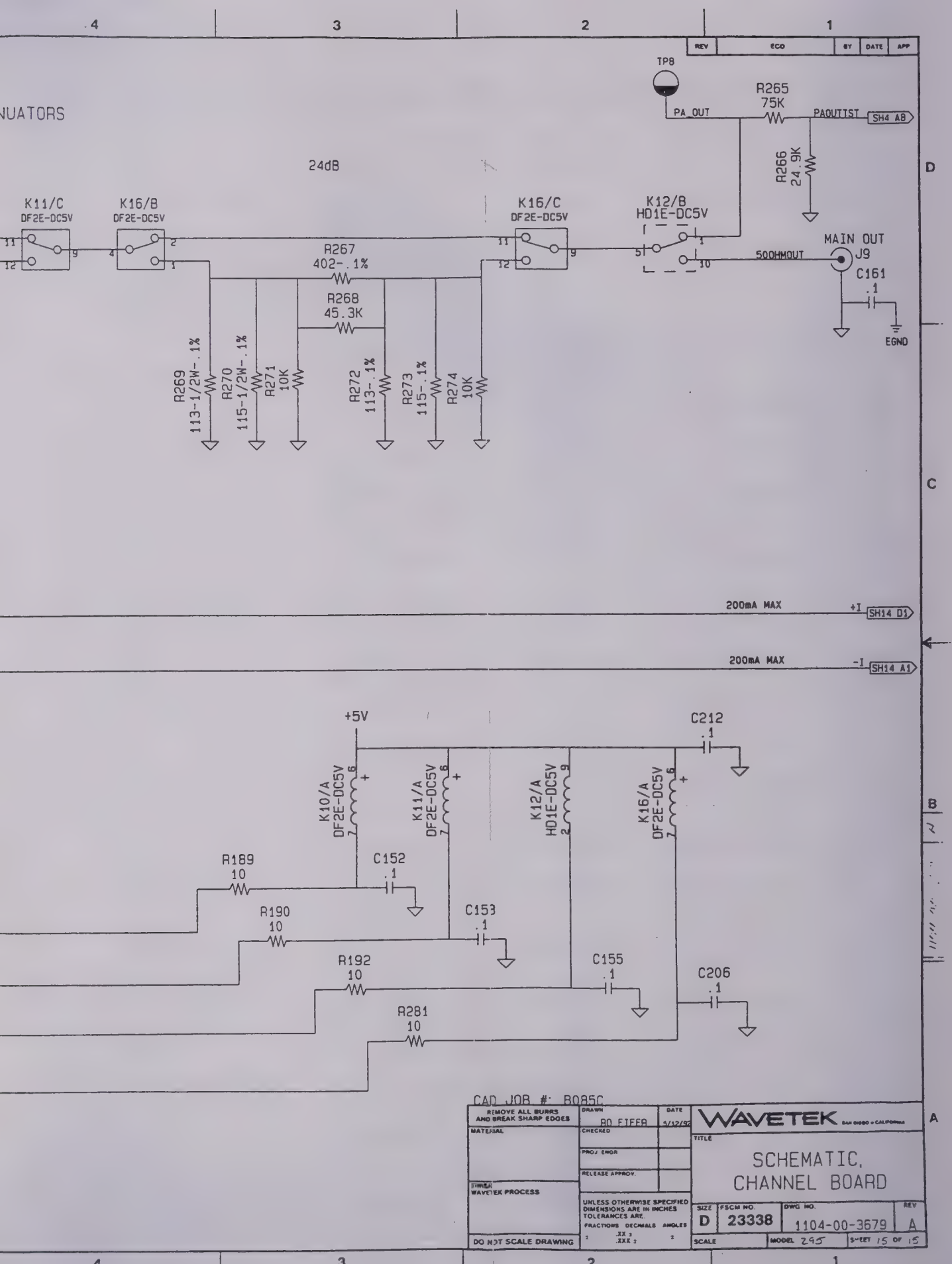
SH3 C1 ATT6DB

SH3 C1 ATT12DB

SH3 C1 OUTPUT

SH3 C1 ATT24DB

NOTE UNLESS OTHERWISE SPECIFIED


REV ECO BY DATE APP
NUATORS
TP8
R265
75K
PA_OUT
PAOUTISI
SH4 A8
R266
24.9K
24dB
K11/C
DF2E-DC5V
K16/B
DF2E-DC5V
K16/C
DF2E-DC5V
K12/B
HD1E-DC5V
R267
402-.1%
R268
45.3K
500HMOUT
MAIN OUT
J9
C161
.1
EGND
R269
113-1/2W-.1%
R270
115-1/2W-.1%
R271
10K
R272
113-.1%
R273
115-.1%
R274
10K
200mA MAX
+I
SH14 D1
200mA MAX
-I
SH14 A1
+5V
C212
.1
K10/A
DF2E-DC5V
K11/A
DF2E-DC5V
K12/A
HD1E-DC5V
K16/A
DF2E-DC5V
R189
10
C152
.1
R190
10
C153
.1
R192
10
C155
.1
C206
.1
R281
10
CAD JOB #: B085C
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH
WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN
BO FIFER
DATE
5/12/92
CHECKED
PROJ ENGR
RELEASE APPROV.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE.
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
SCHEMATIC,
CHANNEL BOARD
SIZE D
FSCM NO. 23338
DWG NO. 1104-00-3679
REV A
SCALE
MODEL 295
SHEET 15 OF 15

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
REF	A/D, ARB ENGINE BOARD	1101-00-3674	WVTK	1101-00-3674	1
REF	SCHEMATIC, ARB ENGINE BOARD	1104-00-3674	WVTK	1104-00-3674	1
C1 C3 C41 C43 C53	CAP,TANT,22 MF,16V,20%,SMD	TAJD226M016R	STANT	1500-72-2001	5
C10 C11 C12 C13 C14 C16 C17 C18 C19 C2 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C37 C38 C39 C4 C40 C42 C44 C45 C46 C5 C6 C7 C8 C9	CAP,CER, 0.1MF, 50V,Z5U, +80-20%,SMD 1206	C1206C104Z5UAC	KEMET	1500-81-0401	40
1	PCB, ARB ENGINE REF: SPEC 0008-00-0455 REV E	1700-00-3523-01	WVTK	1700-00-3523-01	1
DL1	DELAY LINE, 3.0 NS, SINGLE-IN-LINE PKG	EP123107	PCA	1800-00-0062	1
P1A P1B P2A P2B	CONN,HEADER,SNGL ROW,LW PROF,22 PIN	929870-01-22-10	3M	2100-02-0305	4
P3A P3B	SOCKET,BOARD MNT,LOW PROFILE,15 CONTACT	929870-01-15-10	3M	2100-03-0100	2
2	SKT,20PIN,PLCC SM	213-020-601	METHD	2100-03-0103	1
3	SKT, 84 PIN, PLCC, SMD	PLCC-84-T-A	SAM	2100-03-0115	1
TP2 TP6	TEST POINT,BLK,PC	TP-104-01-00	COMPO	2100-04-0054	2
TP1 TP3 TP4 TP5	TEST POINT,RED,PC	TP-104-01-02	COMPO	2100-04-0055	4
4	STANDOFF, SWAGE,6-32X1/8X1/4DIA	B-25000-632-105-22	GLOBE	2800-06-0071	3
FB1 FB2	BALUN CORE,FERRITE,82 OHMS	2743015111	FRITE	3100-00-0018	2
R9	RES,200PPM,1/8W,1%,1.5K OHM,SMD,1206	9C12063A1501FLR	MEPCO	4703-13-1501	1
R10	RES,200 PPM,1/8W,1%,15.8K,SMD,1206	9C12063A1582FLR	MEPCO	4703-13-1582	1
R11	RES,200 PPM,1/8 W,1%,1.65K,SMD,1206	9C12063A1651FLR	MEPCO	4703-13-1651	1
R23	RES, 200PPM, 1%, 1/8W, 249 OHM, 1206,SMD	9C12063A2490FLR	MEPCO	4703-13-2490	1
R18 R19	RES,200 PPM,1/8W,1%,24.9 OHM,SMD,1206	9C12063A24R9FLR	MEPCO	4703-13-2499	2
R16 R17 R20 R21	RES,200 PPM, 1/8W,1%, 453 OHM,SMD,1206	9C12063A4530FLR	MEPCO	4703-13-4530	4
R22	RES,SMD,200PPM,1%,1/8W,49.9ohm	CRCW1206-49.9FT	DALE	4703-13-4999	1
R13 R15 R3 R4 R7 R8	RES, SMD GP 1/8 LONG 200PPM 5% 120 OHM	MCR18EZH121JW5%	ROHM	4703-20-1215	6
R24	RES, SMD GP 1/8 LONG 200PPM 5% 160 OHM	MCR18EZHJW161	ROHM	4703-20-1615	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R1 R12 R14 R2 R5 R6	RES,200 PPM,1/8W,5%,82 OHM,SMD,1206	9C12063A82R0JLR	MEPCO	4703-20-8205	6
RN1 RN2 RN4 RN5 RN7	RES NETWORK 470 10PIN SIP BUSS	4310R-101-471	BOURN	4770-00-0009	5
RN3 RN6	NTWK,RES, 47 OHM, 7 RES,ISOL,SMD	SOMC-1403-470G	DALE	4770-00-0070	2
U19	OP-AMP,HI SLEW RATE, CURNT FEBK,SMD,SO-8	CLC409AJE	COMLR	7000-04-0901	1
U17	RECEIVER,ECL,3 LINE,PLCC	MC10H116FN	MOT	8000-10-0116	1
U18	D/A,12 BIT,50MSPS,ECL INP,PLCC PKG	TDC1112R3C2	TRW	8000-11-1201	1
U4 U5	XCVR,OCTAL,HCTMOS,TTL I/O,SOIC PKG	MC74HCT245ADW	MOT	8000-74-2451	2
U3	GATE,QUAD,2-INP,SOIC PKG	SN74ALS32D	TI	8000-74-3251	1
U10 U11 U12 U8 U9	XLATOR,QUAD,TTL-TO-ME CL,PLCC PKG	MC10H124FN	MOT	8001-01-2402	5
U1 U16	XLATOR,QUAD,TTL-TO-EC L,PLCC PKG	MC10H125FN	MOT	8001-01-2502	2
U13 U14 U15	FLIP-FLOP,D-TYPE,HEX, ECL,PLCC PKG	MC10H176FN	MOT	8001-01-7602	3
U20 U21	SRAM,CMOS, 32K x 8, 15 NS, SOJ PKG	TC55B328J-15	TOSH	8007-12-5616	2
NONE	PLD,EECMOS,GAL16V8, 10 INP, 8 I/O 7.5 NS, 20 PIN PLCC	GAL16V8B-7LJ	LATT	8016-08-0750	1
U2	ASIC,ADDRESS GENE. AND SEQUENCER,AGS4804	8700-00-0007	WVTK	8700-00-0007	1

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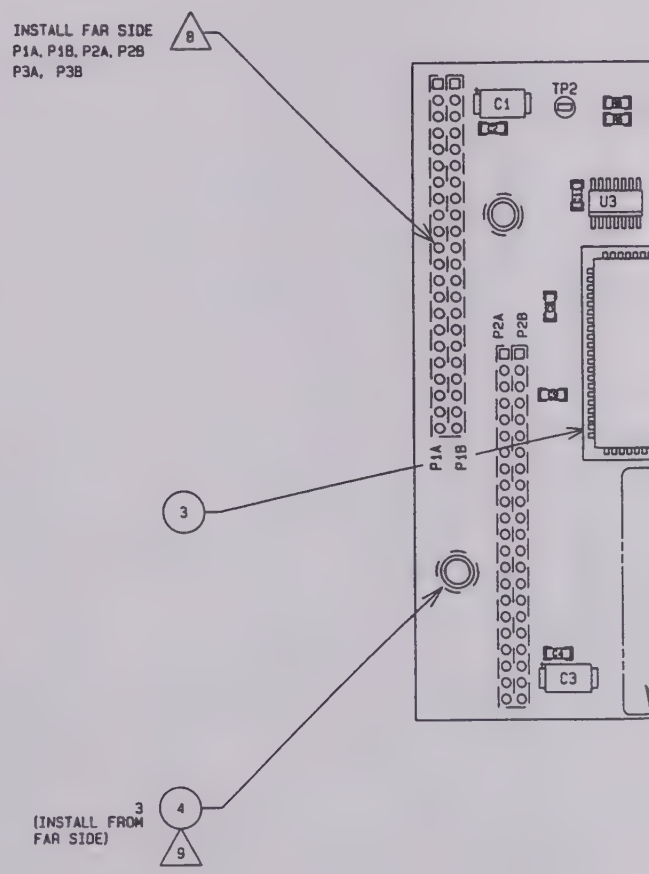
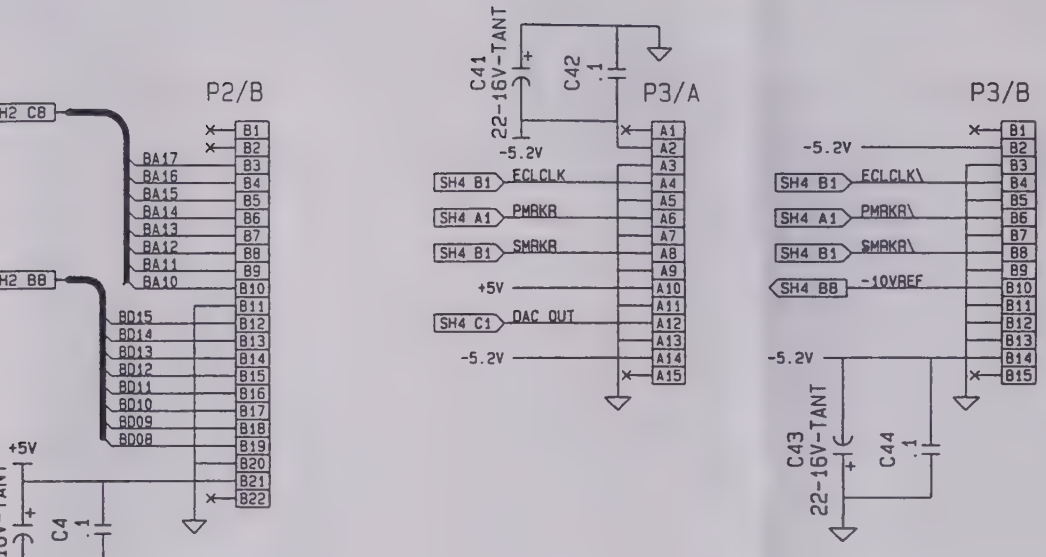
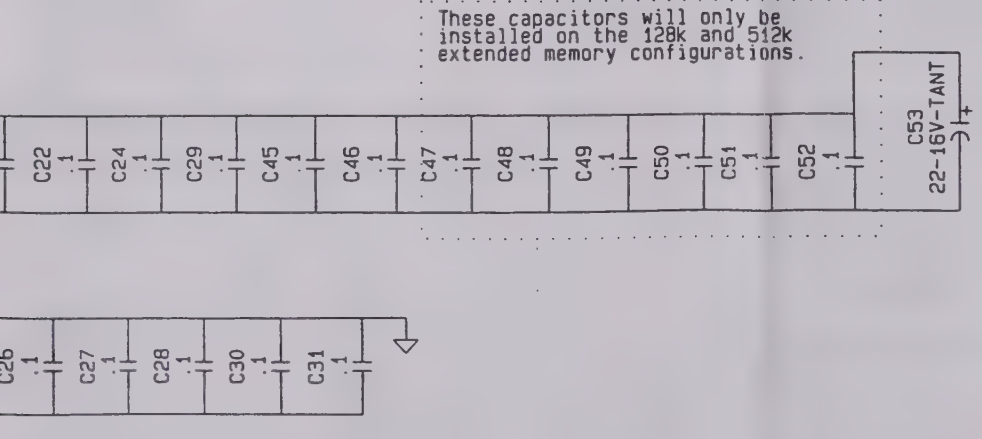


14. SILKSCREEN MAY BE MARKED AS "J1" FOR THIS COMPONENT.
13. DO NOT INSTALL FOR STANDARD OR 128K EXTENDED MEMORY CONFIGURATIONS. INSTALL ONLY FOR 512K EXTENDED MEMORY CONFIGURATION.
12. DO NOT INSTALL FOR STANDARD CONFIGURATION. INSTALL ONLY FOR 128K AND 512K EXTENDED MEMORY CONFIGURATIONS.
11. DO NOT INSTALL FOR STANDARD CONFIGURATION. INSTALL 32Kx8 DEVICES FOR 128K EXTENDED MEMORY CONFIGURATION. INSTALL 128Kx8 DEVICES FOR 512K EXTENDED MEMORY CONFIGURATION.
10. INSTALL 32Kx8 DEVICES FOR STANDARD AND 128K EXTENDED MEMORY CONFIGURATIONS. INSTALL 128Kx8 DEVICES FOR 512K EXTENDED MEMORY CONFIGURATION.
9. INSTALL SWAGE HARDWARE PER MFGR'S RECOMMENDED METHOD.
8. THESE ITEMS MUST BE INSTALLED SO THAT BASE OF PART IS FLUSH AGAINST PCB SURFACE AFTER SOLDER.
7. - - -
6. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
5. PARTIAL REFERENCE DESIGNATIONS SHOWN, PREFIX WITH ASSY REF DES A2.
4. MARK ASSY WITH PART NUMBER, REVISION LEVEL, DATE CODE, AND SEQUENCE NUMBER (OPTIONAL) IN APPROX. AREA SHOWN.
3. ASSEMBLE PER WAVETEK WORKMANSHIP STANDARDS.
2. FOR ASSY INTERCONNECTION, SEE INSTRUMENT SCHEMATIC 1004-00-0675.
1. SEE 1104-00-3523 FOR SCHEMATIC.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-417	NM	9/24/92	RBG
B	ECO 93-201	SC	10-25-93	NM

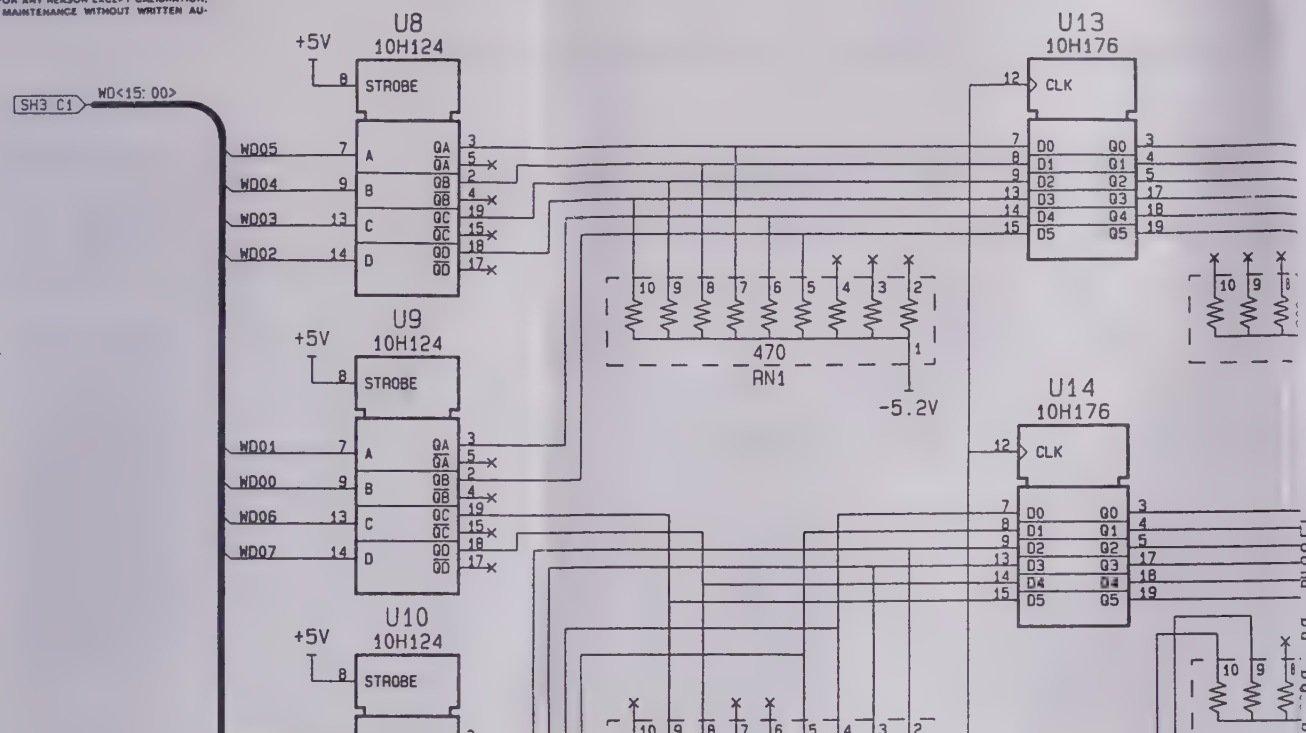


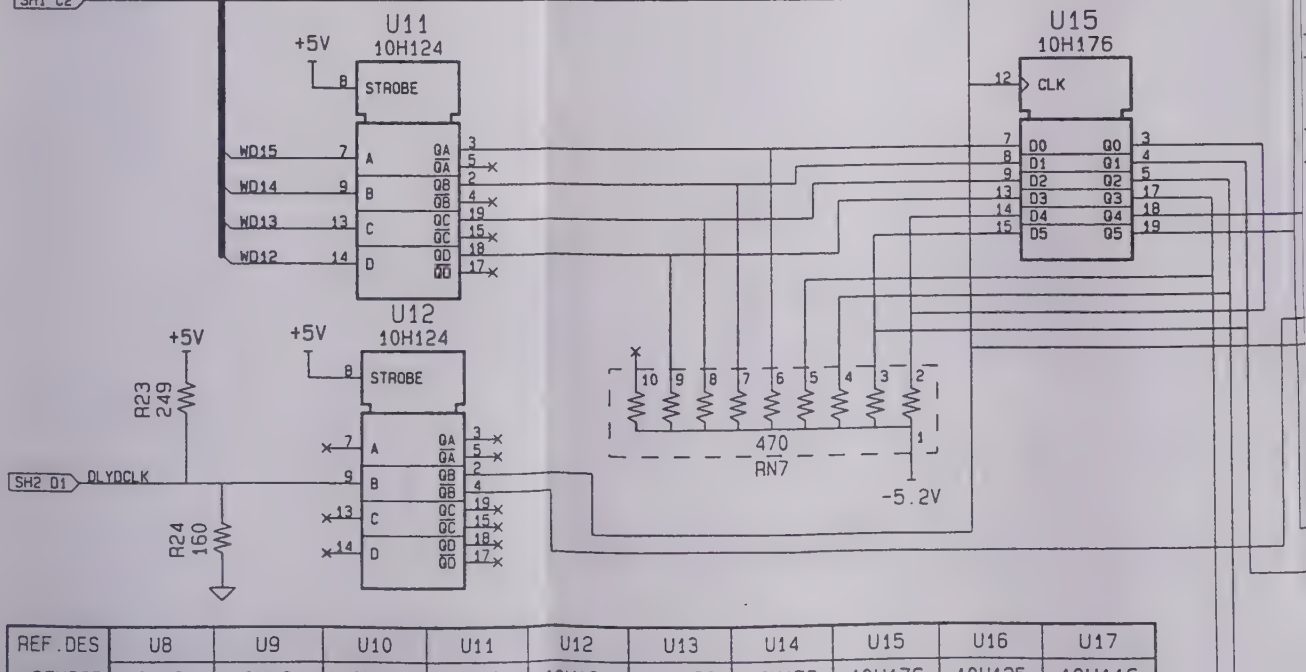


CAD JOB #: B084C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN G. McAllister	DATE 8/19/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: SCHEMATIC, ARB ENGINE BOARD
	PROJ. ENGR.		
FINISH WAVETEK PROCESS	RELEASE APPROV. RBG		SIZE D · FSCM NO. 23338 · DWG. NO. 1104-00-3674 · REV B
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX ± XXX ± ±		SCALE NONE · MODEL 295 · SHEET 1 OF 4

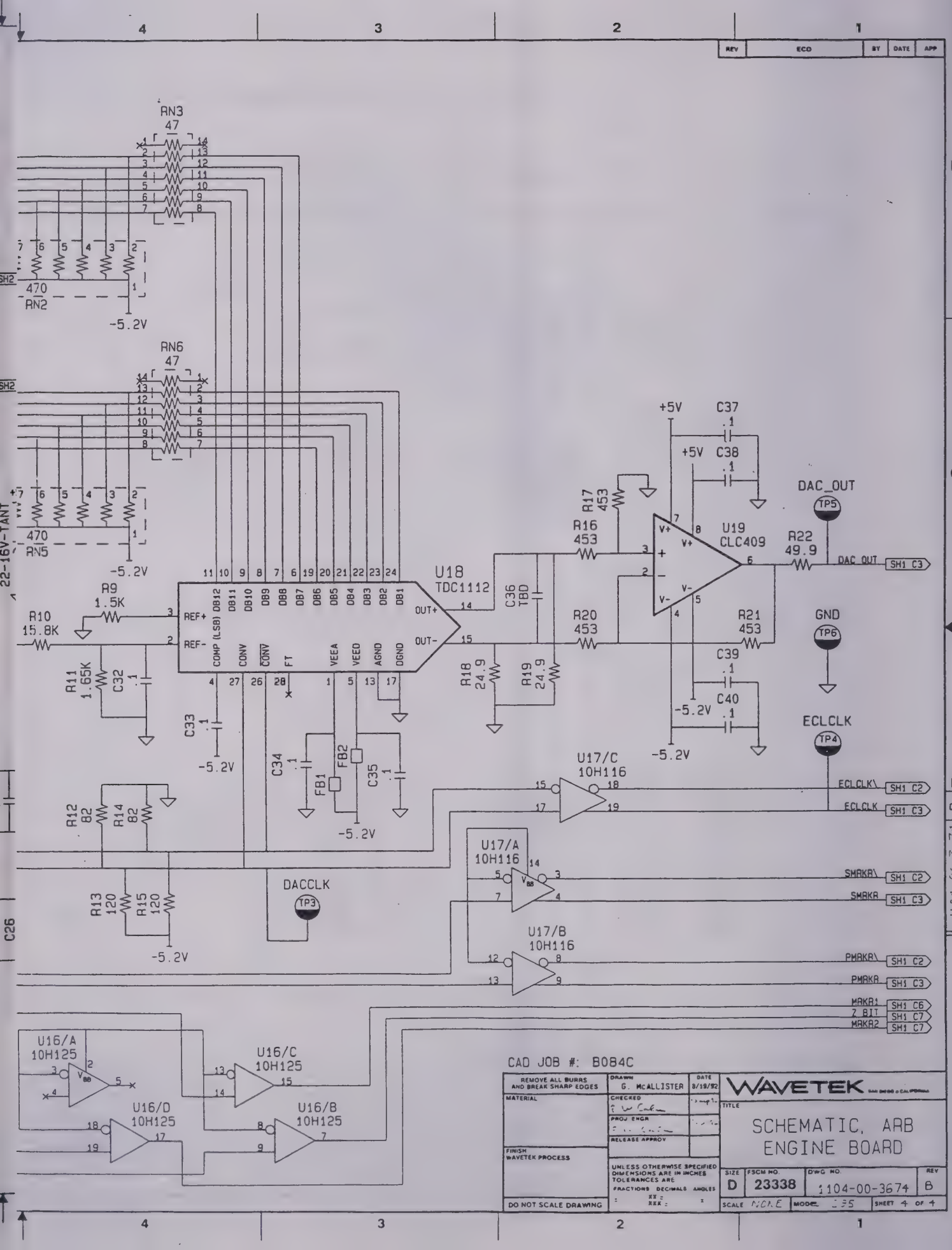
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION





REF. DES	U8	U9	U10	U11	U12	U13	U14	U15	U16	U17
DEVICE	10H124	10H124	10H124	10H124	10H124	10H176	10H176	10H176	10H125	10H116
+5V	12	12	12	12	12				12	
GND	20	20	20	20	20	2, 20	2, 20	2, 20	20	2, 20
-5.2V	10	10	10	10	10	10	10	10	10	10
CAP	C16, C17	C18, C19	C20, C21	C22, C23	C24, C25	C26	C27	C28	C29, C30	C31

NOTE UNLESS OTHERWISE SPECIFIED


REV ECO BY DATE APP
RN3 47
RN2 470
-5.2V
RN6 47
RN5 470
-5.2V
+5V
C37 .1
C38 .1
DAC_OUT
TP5
R17 453
R16 453
U19 CLC409
R22 49.9
DAC_OUT
SH1 C3
U18 TDC1112
R9 1.5K
R10 15.8K
R11 1.65K
C32 .1
C36 TBD
R20 453
R21 453
GND
TP6
R18 24.9
R19 24.9
C39 .1
C40 .1
-5.2V
ECLCLK
TP4
C33 .1
C34 .1
FB1
FB2
C35 .1
U17/C 10H116
ECLCLK\
ECLCLK
R12 82
R14 82
U17/A 10H116
SMAKA\
SMAKA
DACCLK
TP3
R13 120
R15 120
U17/B 10H116
PMAKA\
PMAKA
MAKA1
Z BIT
MAKA2
U16/A 10H125
U16/C 10H125
U16/D 10H125
U16/B 10H125
CAD JOB #: B084C
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN G. McALLISTER 8/19/92
CHECKED
PROJ ENGR
RELEASE APPROV
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES
WAVETEK
TITLE
SCHEMATIC, ARB ENGINE BOARD
SIZE D
FSCM NO. 23338
DWG NO. 1104-00-3674
REV B
SCALE NONE
MODEL 135
SHEET 4 OF 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U31	XCVR,OCTAL INTERFACE BUS,TTL	DS75162AN	NSC	0665-00612	1
U29	GPIB CONTROLLER	TMS9914ANL	TI	0666-00113	1
REF	A/D PROCESSOR BD	1101-00-3497	WVTK	1101-00-3497	1
REF	SCHEMATIC,PROCESSOR BD	1104-00-3497	WVTK	1104-00-3497	1
R49 R53 R54	RES,MFLM 27.2K 1% 1/8W T0	CR125 100PPM	CTLRE	112.2720	3
C86	CAP CER MON .01MF 50V Z5U +80/-20% RAD LD .2	1CZ0Z5U103M0S0B	SPRAG	1500-01-0311	1
C1 C10 C11 C12 C14 C15 C16 C19 C2 C20 C21 C22 C23 C24 C25 C27 C28 C29 C3 C30 C31 C32 C33 C35 C36 C37 C38 C39 C41 C42 C43 C44 C47 C48 C49 C50 C51 C55 C56 C57 C60 C61 C63 C64 C66 C67 C70 C72 C82 C9	CAP,CER,.1 MF,50V,X7R,+-10%,.1" LS	SR205C104KAA	AVX	1500-01-0415	50
C52 C53 C58	CAP,CER,15PF,1KV	D15DK20S2LNAAAL	PHLIP	1500-01-5011	3
C83	CAP CER MON 22PF 50V COG 5% RADIAL LD SP .2	5028E050RD220J	KYCRA	1500-02-2016	1
C59 C62 C69 C71	CAP,CER,470PF,1KV	DD-471	CRL	1500-04-7111	4
C65	CAP,MICA,75PF,500V	DM15-750J	ARCO	1500-17-5000	1
C54	CAP,ELECT,10MF/25V RADIAL LEAD, SP .10	NRE 10/63	NIC	1500-31-0002	1
C73 C74 C75 C76 C78 C79 C80 C81 C84 C85	CAP,ELECT,22MF,25V,RADIAL	SRA25V822RM6X7LL	UNCON	1500-32-2002	10
C77	CAP,MET-POLY,5%.47MF, 63V RADIAL LEAD SP .2	168474J63F	MALRY	1500-44-7413	1
1	PCB, PROCESSOR BD REF: SPEC 0008-00-0455 REV E	1700-00-3497	WVTK	1700-00-3497	1
L1	CHOKE,3.3MH,10%	1537-24	DLVAN	1800-00-0006	1
J4	HEADER W/EJECTOR,50 PIN,PC-MOUNT	3433-6402	3M	2100-02-0295	1
P1	CONN,DIN,PLUG,REVERSE ,96 PIN,ST,PC MNT	DIN-96-RPC-S1-TR	ROBNU	2100-02-0298	1
J1	CONN,HEADER,14 PIN,.049 CNTR,FLEX CABLE	39-51-3144	MOLEX	2100-02-0302	1
J3	CONN,HEADER,4-WALL,RA	3594-50K2	3M	2100-02-0303	1
J5 J6 J7 J8	CONN,HDR, 0.1 CNTR, 0.025 x 0.025 POST LOCKING RAMP	640456-2	AMP	2100-02-0319	4
XU29 XU32	SKT,IC,40PIN	DILB40P-108T	BURND	2100-03-0030	2
XU37	SOCKET,20 PIN	DILB20P-108T	BURND	2100-03-0051	1
XU25	SKT,IC,28PIN	DILB28P-108T	BURND	2100-03-0055	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
XU20 XU21	SOCKET,DUAL BEAM,LO RISE, 24 PIN	802-0241642	WELCN	2100-03-0088	2
J2	CONN,20 PIN SHROUDED HEADER	103169-8	AMP	2100-03-0105	1
XU16	SOCKET,68 PIN, PLCC,THRU-HOLE	821574-1	AMP	2100-03-1574	1
XU11 XU27	SOCKET,IC,PLCC,44PIN, THRU-HOLE	QILE44P-410T(REF ONLY)	BURND	2100-03-1575	2
TP1 TP5	TEST POINT,BLK,PC	TP-104-01-00	COMPO	2100-04-0054	2
TP2 TP3 TP4	TEST POINT,RED,PC	TP-104-01-02	COMPO	2100-04-0055	3
U51	OSCILLATOR, TEMP COMPENSATED 10MHZ XTAL, 14 PIN DIP, 0.030 LEADS	74008ZA1	MONIT	2300-99-0026	1
Y1	CRYSTAL, 3.6864MHZ	FOX03685	FOX	2300-99-0029	1
U36	OSCILLATOR,32 MHZ, TTL	F1100-32.0 MHZ	FOX	2300-99-0035	1
XBT1	BATTERY HOLDER	BH 2/3A	MPD	3000-00-0137	1
BT1	BATTERY, 3V LITHIUM	BR-2/3A	PANAS	4000-02-0008	1
K1	RELAY,1 FORMC,5V,.312H,.296W	HD1E-M-DC5V	AROMT	4500-00-0034	1
R2 R20 R24 R40 R47	RES,MF,1/8W,1%,100	RN55D-1000F	TRW	4701-03-1000	5
R21 R27 R28 R42 R7	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	5
R25 R4 R44 R45 R46 R5	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	6
R51 R52	RES,MF,1/8W,1%,100K	RN55D-1003F	TRW	4701-03-1003	2
R50	RES,MF,1/8W,1%,1M	RN55D-1004F	TRW	4701-03-1004	1
R18	RES,MF,1/8W,1%,10	5043ED10R100F	MEPCO	4701-03-1009	1
R12 R13 R31	RES,MF,1/8W,1%,1.21K	RN55D-1211F	TRW	4701-03-1211	3
R23	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	4701-03-2001	1
R1 R36	RES,MF,1/8W,1%,249	RN55D-2490F	TRW	4701-03-2490	2
R10	RES,MF,1/8W,1%,2.49K	RN55D-2491F	TRW	4701-03-2491	1
R22	RES,MF,1/8W,1%,3.01K	RN55D-3011F	TRW	4701-03-3011	1
R8 R9	RES,MF,1/8W,1%,4.02K	RN55D-4021F	TRW	4701-03-4021	2
R6	RES,MF,1/8W,1%,4.32K	RN55D-4321F	TRW	4701-03-4321	1
R34 R35	RES,MF,1.8W,1%,46.4	RN55D-46R4F	TRW	4701-03-4649	2
R14 R17 R29 R33 R48	RES,MF,1/8,1%,499	RN55D-4990F	TRW	4701-03-4990	5
R11 R19 R55	RES,MF,1/8W,1%,4.99K	RN55D-4991F	TRW	4701-03-4991	3
R3	RES,MF,1/8W,1%,6.98K	RN55D-6981F	TRW	4701-03-6981	1
R26	RES,MF,1/8W,1%,750	RN55D-7500F	TRW	4701-03-7500	1
R30 R32	RES,MF,1/8W,1%,825	RN55D-8250F	TRW	4701-03-8250	2
R15	RES,MF,1/8W,1%,909	RN55D-9090F	TRW	4701-03-9090	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
RN2 RN3 RN5	RES NETWORK 10K 2% 10PIN SIP BUSS	4310R-101-103	BOURN	4770-00-0008	3
RN1 RN4	RES NETWORK 1K 2% 10PIN SIP BUSS	4310R-101-102	BOURN	4770-00-0022	2
CR5	DIODE, ZENER 9.1V, GLASS SILICON, 500MW	1N5239	TEL	4801-01-5239	1
CR1 CR11 CR14 CR16 CR2 CR3 CR4 CR6 CR7 CR8	DIODE, HIGH CONDUCTANCE, ULTRA FAST	1N5282	FAIR	4801-01-5282	10
CR10 CR12 CR13 CR15 CR9	DIODE 5082-2811 SCHOTTKY,15V,20MA	5082-2811	HP	4809-02-2811	5
DS1	LED,GREEN,RECT BAR	LTL-3231A	LITE	4899-00-0057	1
Q1 Q2 Q3 Q6	TRANS 2N3904 NPN GENERAL PURPOSE TO-92	2N3904	FAIR	4901-03-9040	4
Q5		GENERAL PURPOSE TO-92			
Q4	TRANS	VN10KM	SLCON	4902-00-0100	1
SW1 SW2	SWITCH,MIN PUSHBUTTON,SPST BLK	39-405	GRAHL	5102-00-0015	2
U52	COMPARATOR, LOW POWER LOW OFFSET VOLTAGE DUAL	LM393N	NSC	7000-03-9300	1
U49	COMPARATOR, DUAL DIFFERENTIAL, SENSE AMP	NE521N	SIG	7000-05-2100	1
U47	COMPARATOR,ULTRA FAST,10NS	LT1016CN8	LINTE	7000-10-1600	1
U44	VOLTAGE REFERENCE, 10V, 8 PIN DIP	LT1021CCN8-10	LINTE	7000-10-2101	1
U46	OP AMP,HI SLEW RTE,WIDEBND,JFET DUAL	MC34082P	MOT	7003-40-8200	1
U10	PWR MONITOR,BAT MANAGER,5%	DS1236-5	DALAS	8000-12-3600	1
U22	CONT,LCD,CMOS,SMD,60 PIN	SED1330F	S-MOS	8000-13-3000	1
U33	RS-232C QUAD LINE DRIVER	MC1488P	MOT	8000-14-8800	1
U35	RS-232C QUAD LINE RECEIVER	MC1489L	MOT	8000-14-8900	1
NONE	GAL,16V8,15NS	GAL16V8A-15P	LATT	8000-16-8002	1
NONE	GAL,E2 CMOS,64X40,PROGRAMMABLE AND ARRAY, 24 PIN,15NS,PDIP	GAL20V8-15LP	LATT	8000-20-8015	2
U25	SRAM,32K X 8,120NS,28 PIN,DIP	TC55257-BPL-10L	TOSH	8000-43-2560	1
U45	DAC, QUAD 8-BIT	AD7226-JN	ANDEV	8000-72-2600	1
U9	HEX INVERTER W/OC	SN74ALS05AN	TI	8000-74-0501	1
U48	GATE XOR, QUAD 2INP, TTL	74LS86	TI	8000-74-8610	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U2 U3	COUNTER,BIN,RIP/CAR,CMOS	CD4020BE	RCA	8001-40-2000	2
U12 U14	SRAM,128Kx8,100 NS,LO PWR,600 MIL	HM628128LP-10	HTACH	8006-28-1282	2
U16	MICROPROCSR,16-BIT,16 MHZ,HCMOS,68 PIN PLCC	MC68HC000FN16	MOT	8006-80-0016	1
U32	UART DUAL	MC68681P	MOT	8006-86-8100	1
U50	GATE, NAND, QUAD S/TRIG, TTL	SN74LS132N	TI	8007-41-3210	1
U19 U24	DECODER/DEMUX,3 TO 8,TTL	SN74F138N	TI	8007-41-3820	2
U15	ENCODER,8-3,10-4,PRIORITY	74LS148	TI	8007-41-4810	1
U1	COUNTER, DUAL 4B BIN, TTL	74LS393	TI	8007-43-9310	1
U41 U42 U43	BUF/LN DRIVER, OCTAL W/3 STATE	SN74ALS541N	TI	8007-45-4100	3
U23	BUFFER,OCTAL,TS,HCMOS	SN74HC541N	TI	8007-45-4140	1
U28 U38 U39	TRANSCEIVER, OCTAL BUS W/3 STATE	SN74ALS645A-1N	TI	8007-46-4500	3
U30	XCVR,OSC BUS,TTL	75160	TI	8007-51-6000	1
NONE	EPROM, 256Kx16, 120 NS,CMOS	HN27C4096CC-12	HTACH	8027-40-9612	1

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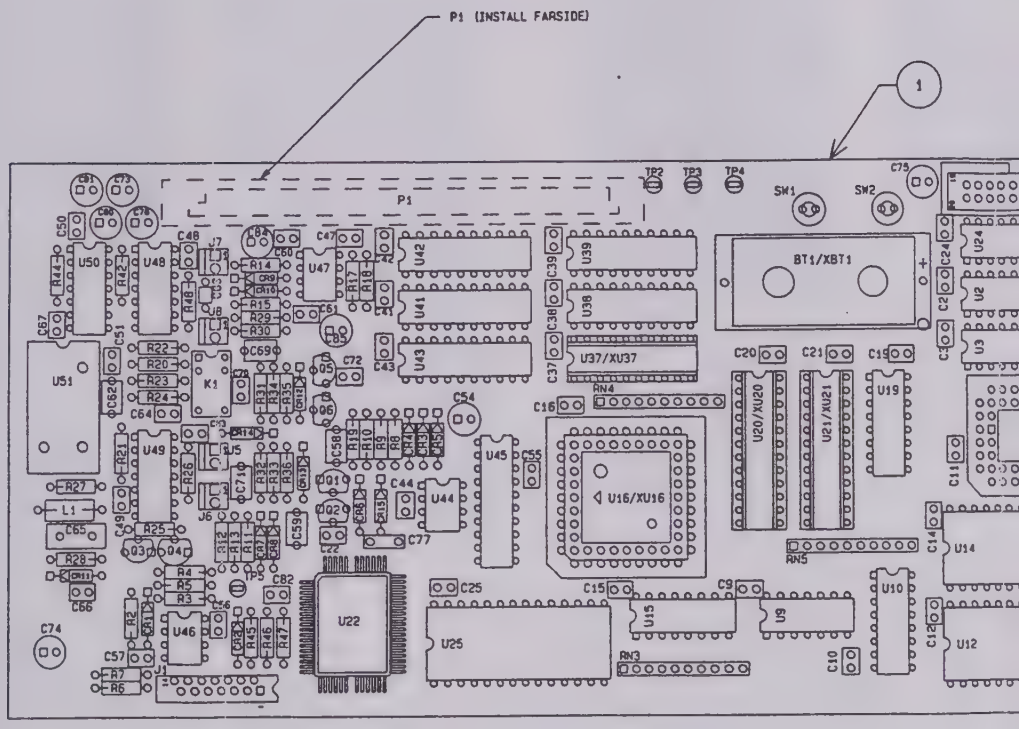


9. REWORK IS APPLICABLE TO -04 AND ON CONFIGURATIONS ONLY.

8. INSTALL U27 ONLY IF FLOPPY DISK DRIVE OPTION (002) IS INSTALLED.

7. INSTALL HARDWARE PER MANUFACTURER'S INSTRUCTIONS.

6. DRAWING CONTENT IS APPLICABLE TO DASH NUMBER CONFIGURATIONS

5. PARTIAL REFERENCE DESIGNATIONS SHOWN. PREFIX WITH ASSY REF DES A .

4. MARK ASSY WITH PART NUMBER, REVISION LEVEL, DATE CODE, AND SEQUENCE NUMBER (OPTIONAL) IN APPROX. AREA SHOWN.

3. ASSEMBLE PER WAVETEK WORKMANSHIP STANDARDS.

2. FOR ASSY INTERCONNECTION, SEE INSTRUMENT SCHEMATIC 1004-00-0675.

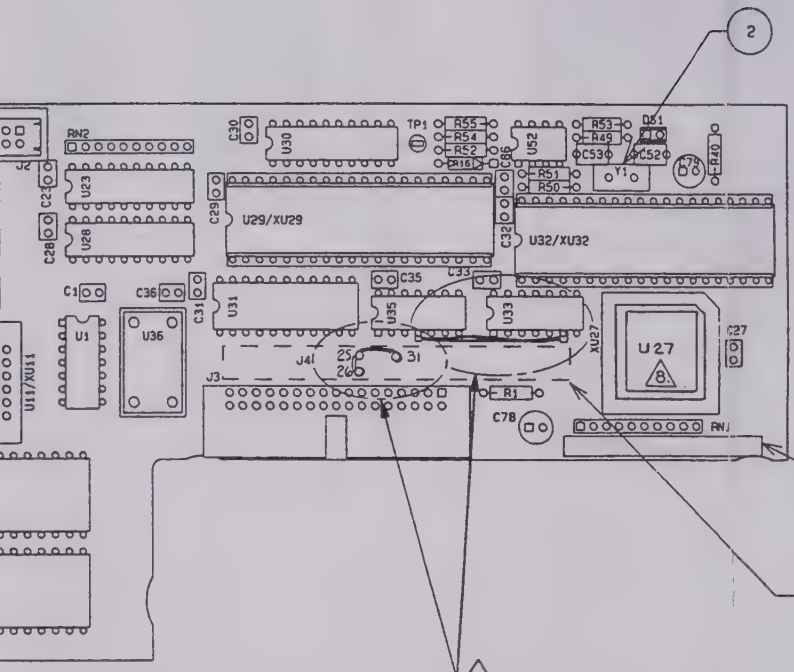
1. SEE 1104-00-3497 FOR SCHEMATIC.

WIRE, 30AWG, WHT
(4000-53-0009)

MODIFI
ALL REW
SIDE OF

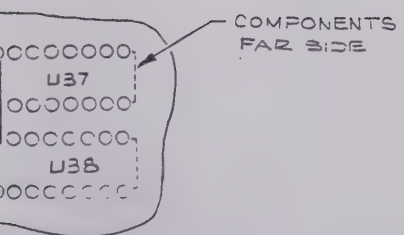
NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-274	BR	6-8-92	RJV
B	ECO 93-005	SC	10-27-92	MBT
C	ECN 93-188	SC	3-14-94	MM
D	ECN 94-0057	SC	3-14-94	MM



REWORK AS FOLLOWS:

1. LIFT PIN 4 OF U35.
2. LIFT PIN 6 OF U33.
3. SOLDER 30AWG INSULATED WIRE FROM PIN 4 OF U35 TO PAD UNDER U33, PIN 6 ON COMP. SIDE.
4. SOLDER 30AWG INSULATED WIRE FROM PIN 6 OF U33 TO PAD UNDER U35, PIN 4 ON COMP. SIDE.
5. ADD 30AWG INSULATED JUMPER BETWEEN J4 PIN 25, J4 PIN 26 AND J4 PIN 31 ON COMP. SIDE.



TION INSTRUCTIONS
APPLIED TO SOLDER
CB.

CAD JOB #: B080C

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN A. Tarr	DATE 6-3-92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED	2 JUN 92	TITLE: PCA, PROCESSOR BOARD
	PROJ. ENGR. RBG	6/8/92	
	RELEASE APPROV. RJV	6/8/92	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES ± XX: ± XXX: ±		SIZE D · FSCM NO. 23338 · DWG NO 1101-00-3497 · REV D
DO NOT SCALE DRAWING			SCALE NONE · MODEL 295 · SHEET 1 OF 1

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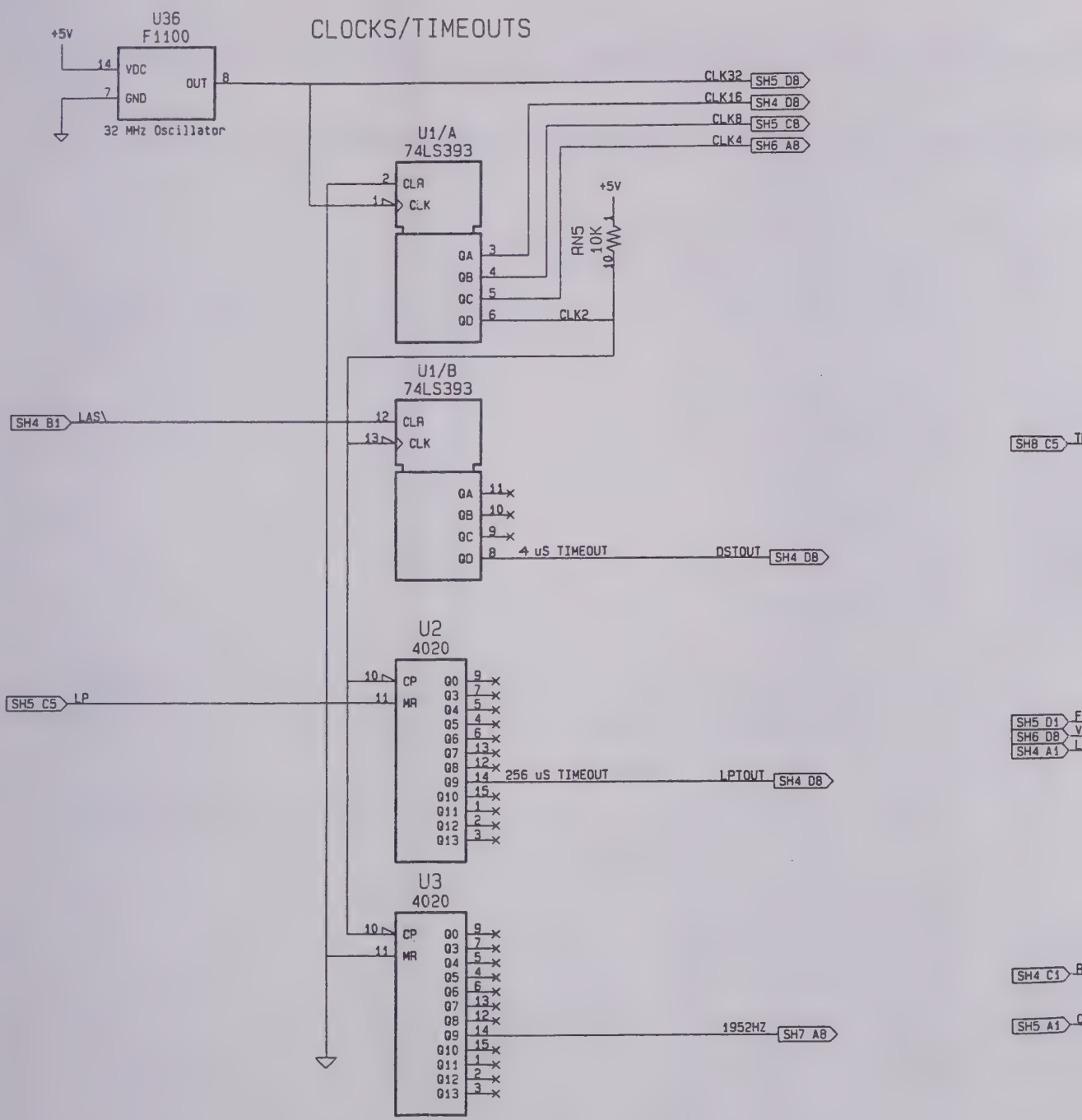
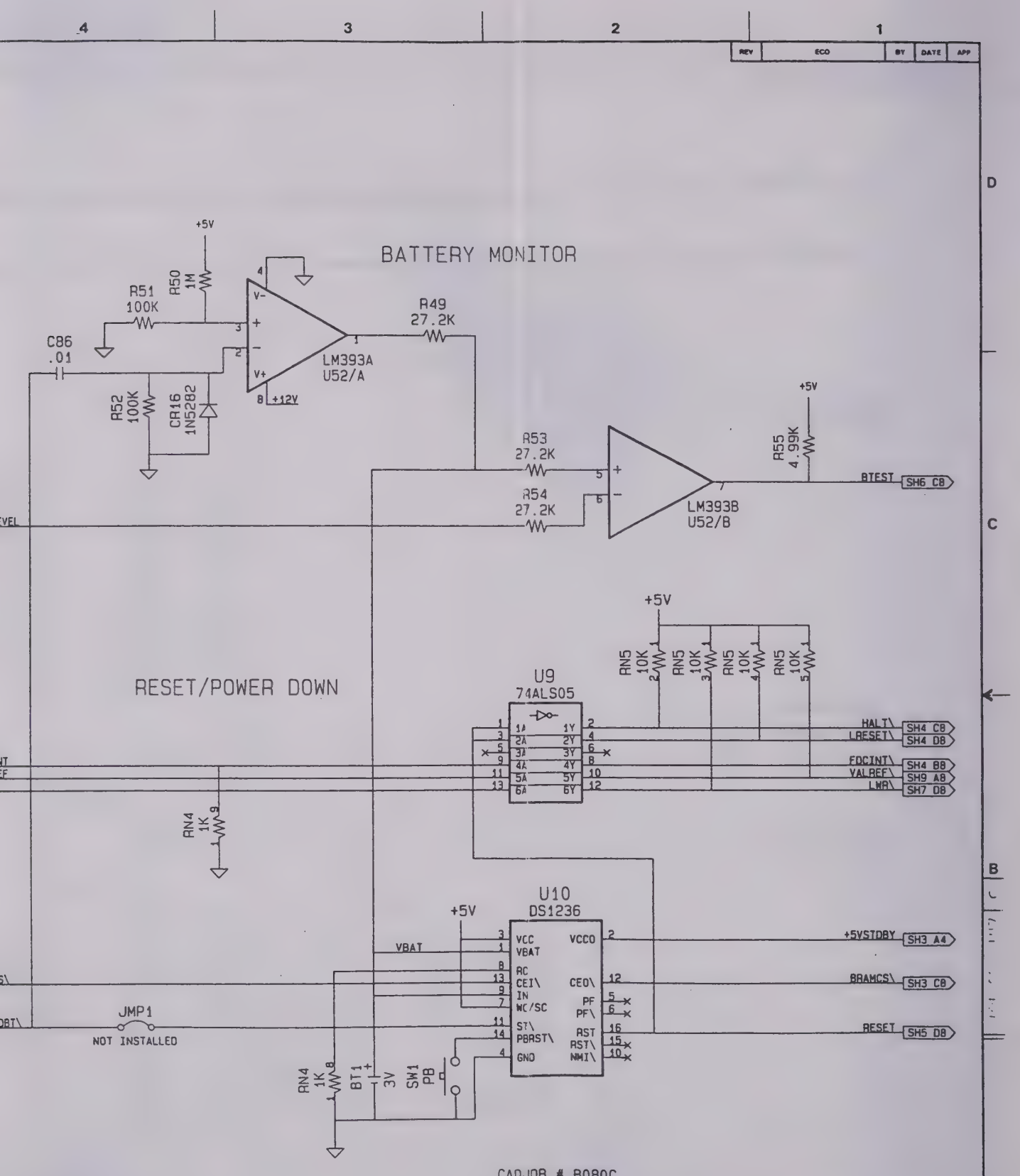
CLOCKS/TIMEOUTS



REF.DES	U1	U2	U3	U9
DEVICE	74LS393	4020	4020	74ALS05
+5V	14	16	16	14
GND	7	8	8	7
CAP	C1	C2	C3	C9

NOTE UNLESS OTHERWISE SPECIFIED



CADJOB # B080C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. Calnan 4-25-92	WAVETEK SAN DIEGO, CALIFORNIA	
MATERIAL	CHECKED Eric Calnan	TITLE	SCHEMATIC, PROCESSOR BOARD
FINISH WAVETEK PROCESS	PROJ ENGR.		
DO NOT SCALE DRAWING	RELEASE APPROV.	SIZE D / FSCM NO. 23338 / DWG. NO. 1104-00-3497 / REV C	
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE. FRACTIONS DECIMALS ANGLES .XX ± .XXX ±	SCALE NONE / MODEL 295 / SHEET 2 OF 9	

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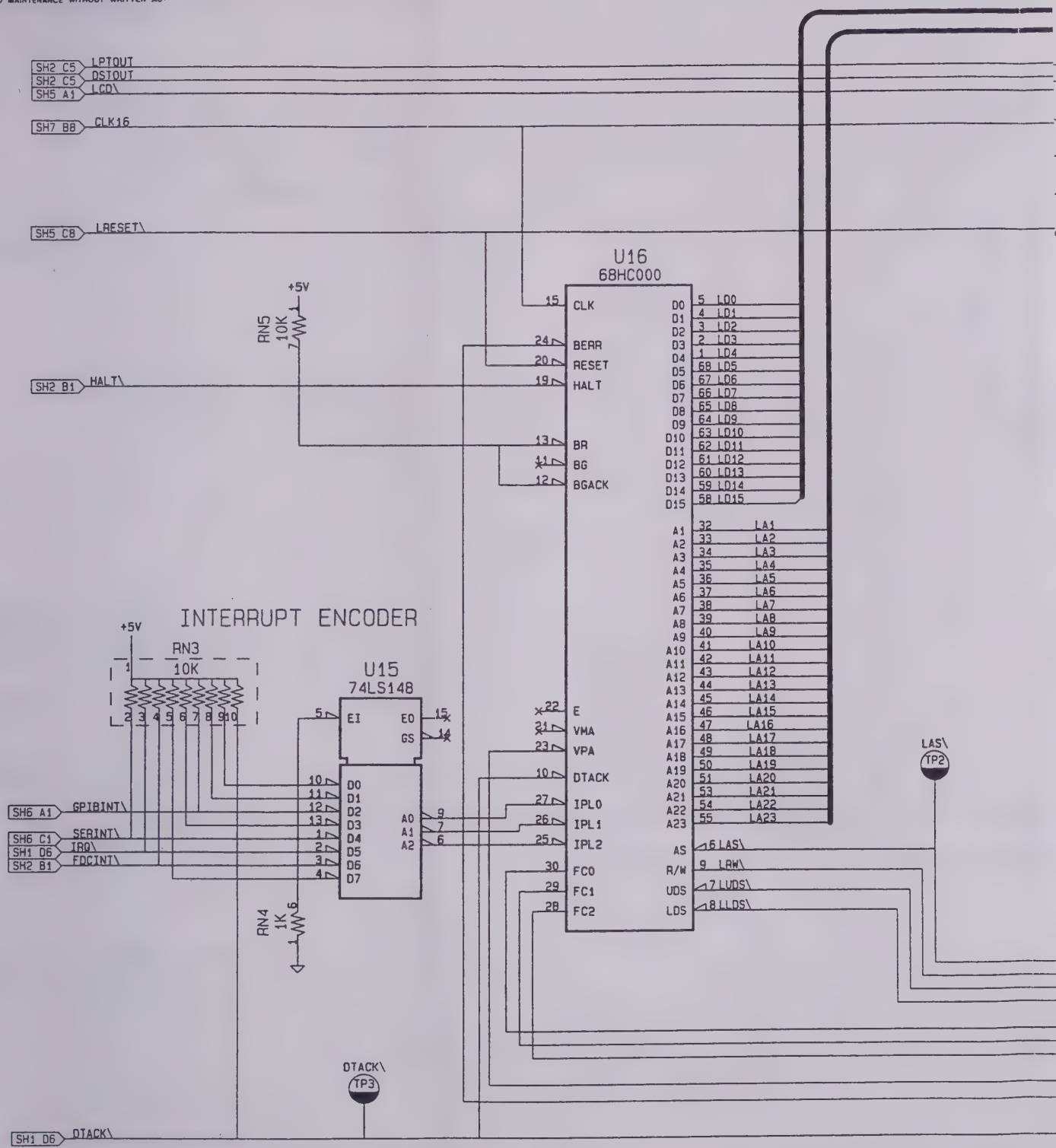
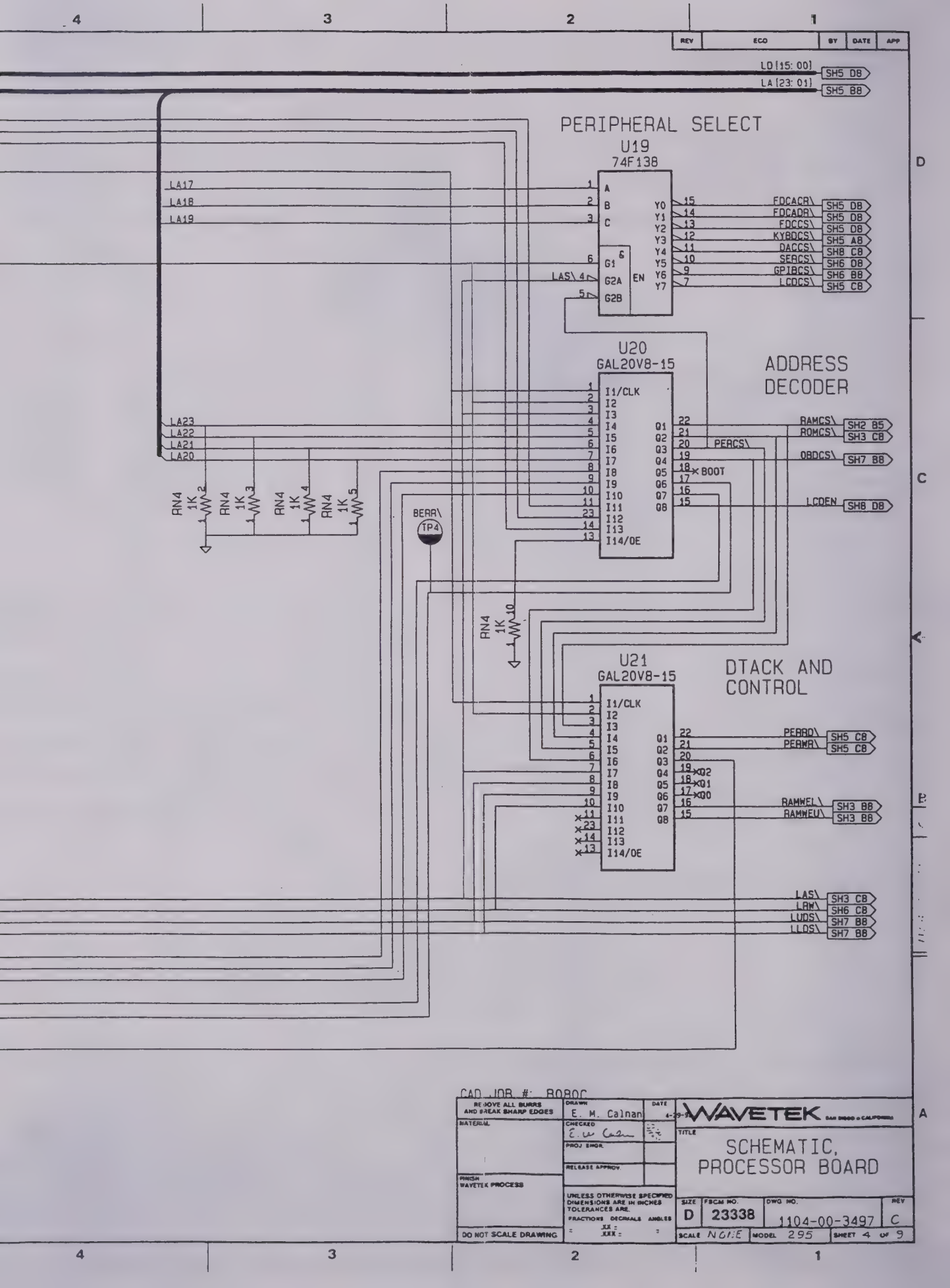


REF.DES	U15	U16	U19	U20	U21
DEVICE	74LS148	68HC00	74F138	GL20V8	GL20V8
+5V	16	14, 52	16	24	24
GND	8	16, 17, 56, 57	8	12	12
CAP	C15	C16	C19	C20	C21

NOTE UNLESS OTHERWISE SPECIFIED


REV
ECO
BY
DATE
APP
LD[15:00]
LA[23:01]
SH5 D8
SH5 B8
PERIPHERAL SELECT
U19
74F138
LA17
LA18
LA19
A
B
C
G1
G2A
G2B
EN
LAS\
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
FDCACR\
FDCADR\
FDCCS\
KYBDCS\
DACCS\
SERCS\
GPIBCS\
LCDCS\
SH5 D8
SH5 D8
SH5 D8
SH5 A8
SH8 C8
SH6 D8
SH6 B8
SH5 C8
U20
GAL20V8-15
ADDRESS
DECODER
LA23
LA22
LA21
LA20
I1/CLK
I2
I3
I4
I5
I6
I7
I8
I9
I10
I11
I12
I13
I14/OE
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
RAMCS\
ROMCS\
PERCS\
OBDCS\
BOOT
LCDEN
SH2 B5
SH3 C8
SH7 B8
SH8 D8
RN4
1K
BERR\
TP4
U21
GAL20V8-15
DTACK AND
CONTROL
PERRD\
PERWR\
RAMWEL\
RAMWEU\
SH5 C8
SH5 C8
SH3 B8
SH3 B8
LAS\
LAM\
LUDS\
LLDS\
SH3 C8
SH6 C8
SH7 B8
SH7 B8
CAD JOB #: B080C
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH
WAVETEK PROCESS
DO NOT SCALE DRAWING
DRAWN
E. M. Calnan
DATE
4-29-97
CHECKED
PROJ ENGR.
RELEASE APPROV.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
WAVETEK
TITLE
SCHEMATIC,
PROCESSOR BOARD
SIZE
D
FSCM NO.
23338
DWG NO.
1104-00-3497
REV
C
SCALE NONE
MODEL 295
SHEET 4 OF 9

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SH9 B1 VALREF
SH4 C1 LCOEN
SH1 C1 RTSA

U35/B
1489
5
4
RC

SH1 C1 RXDA

PERIPHERAL DATA BUFFER

SH5 B8 PD[7:0]
SH4 D1 SERCS\
SH7 D8 LD[07:00]

U28
74ALS645A-1

SH7 A8 PEREN\
SH7 B8 LRW\

EN
DIR [BA]
DIR [AB]

PD0	2	A1	B1	18	LD0
PD1	3	A2	B2	17	LD1
PD2	4	A3	B3	16	LD2
PD3	5	A4	B4	15	LD3
PD4	6	A5	B5	14	LD4
PD5	7	A6	B6	13	LD5
PD6	8	A7	B7	12	LD6
PD7	9	A8	B8	11	LD7

SH7 B8 LA[04:01]

SH2 C1 BTEST
SH5 B1 PROBE\
SH1 D3 HD
SH1 B1 RXDB

GPIB CONTROL

U29
WD9914

PD7	17	D0	DIO1	38	
PD6	16	D1	DIO2	37	
PD5	15	D2	DIO3	36	
PD4	14	D3	DIO4	35	
PD3	13	D4	DIO5	34	
PD2	12	D5	DIO6	33	
PD1	11	D6	DIO7	32	
PD0	10	D7	DIO8	31	
	5	DBIN			
SH4 B1 PEAWR\	4	WE	TE	21	
SH4 D1 GPIBCS\	3	CE	CONT	30	
			TR	39	
LA1	6	RS0			
LA2	7	RS1	ATN	28	
LA3	8	RS2	EOI	27	
	x1	ACCRQ	SRQ	29	
SH5 B1 PULLUPIO	2	ACCGR	REN	22	
			IFC	23	
	9	INT	DAV	26	
SH2 D5 CLK4	18	CLK	NDAC	24	
SH2 B1 LRESET\	19	RESET	NRFD	25	

U30
75160

	11	PE			
	1	TE			
	19	D1	B1	2	DIO1
	18	D2	B2	3	DIO2
	17	D3	B3	4	DIO3
	16	D4	B4	5	DIO4
	15	D5	B5	6	DIO5
	14	D6	B6	7	DIO6
	13	D7	B7	8	DIO7
	12	D8	B8	9	DIO8

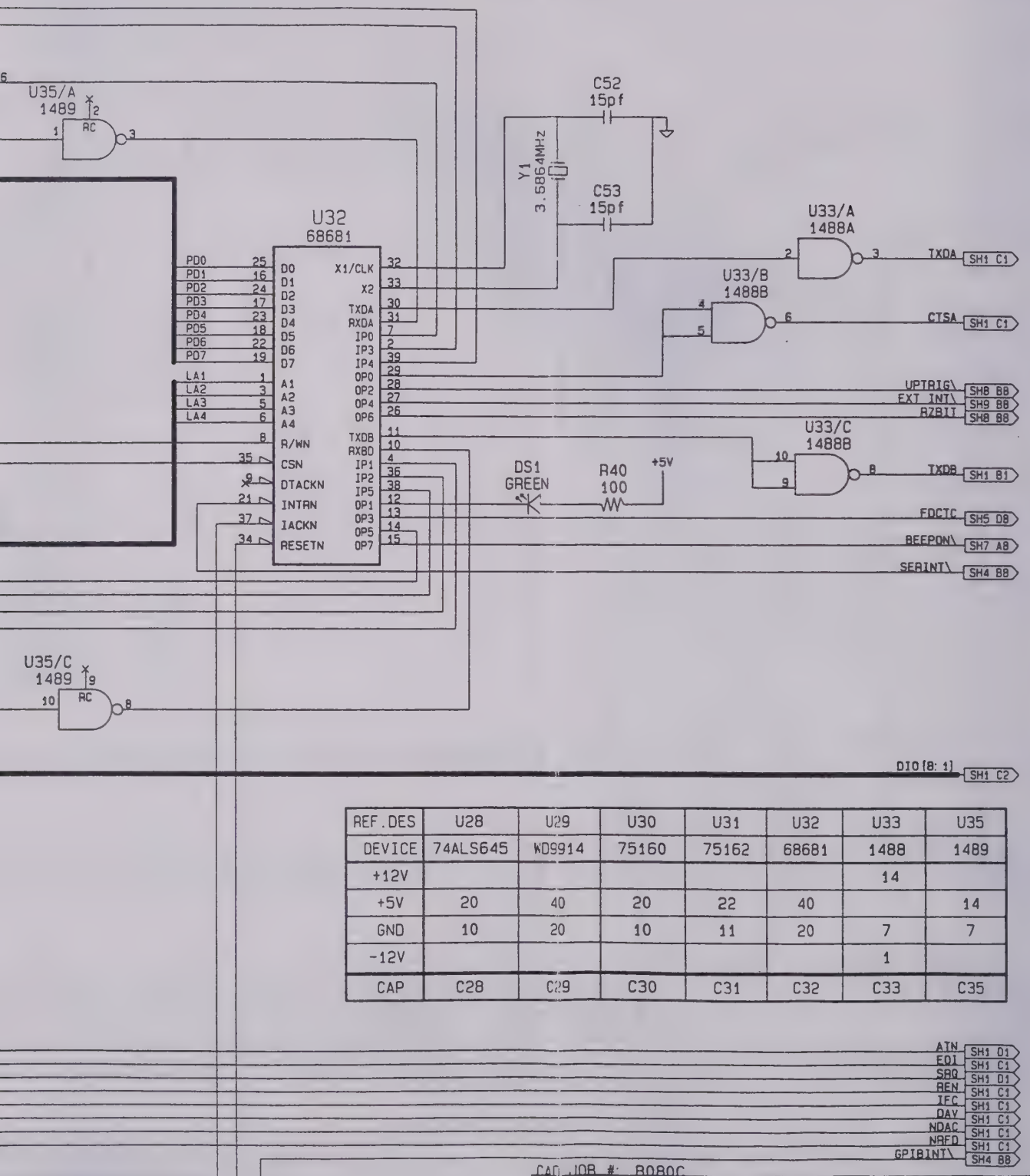
U31
75162

	12	DC			
	2	TE			
	1	SC			
	14	D1	ATN	B1	9
	15	D2	EOI	B2	8
	13	D3	SRQ	B3	10
	20	D4	REN	B4	3
	19	D5	IFC	B5	4
	16	D6	DAV	B6	7
	18	D7	NDAC	B7	5
	17	D8	NRFD	B8	6

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP

RS232 INTERFACE AND PERIODIC TIMER



REF.DES	U28	U29	U30	U31	U32	U33	U35
DEVICE	74ALS645	WD9914	75160	75162	68681	1488	1489
+12V						14	
+5V	20	40	20	22	40		14
GND	10	20	10	11	20	7	7
-12V						1	
CAP	C28	C29	C30	C31	C32	C33	C35

ATN SH1 D1
EOI SH1 C1
SRQ SH1 D1
REN SH1 C1
IFC SH1 C1
DAV SH1 C1
NDAC SH1 C1
NRFD SH1 C1
GPIBINT\ SH4 B8

CAD JOB #: B080C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN E.M. Calnan	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED E.M. Calnan		TITLE: SCHEMATIC, PROCESSOR BOARD
	PROJ. ENGR		
FINISH WAVETEK PROCESS	RELEASE APPROV		
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±		SIZE D · FSCM NO. 23338 · DWG. NO. 1104-20-3497 · REV C · SCALE NONE · MODEL 235 · SHEET 6 OF 9

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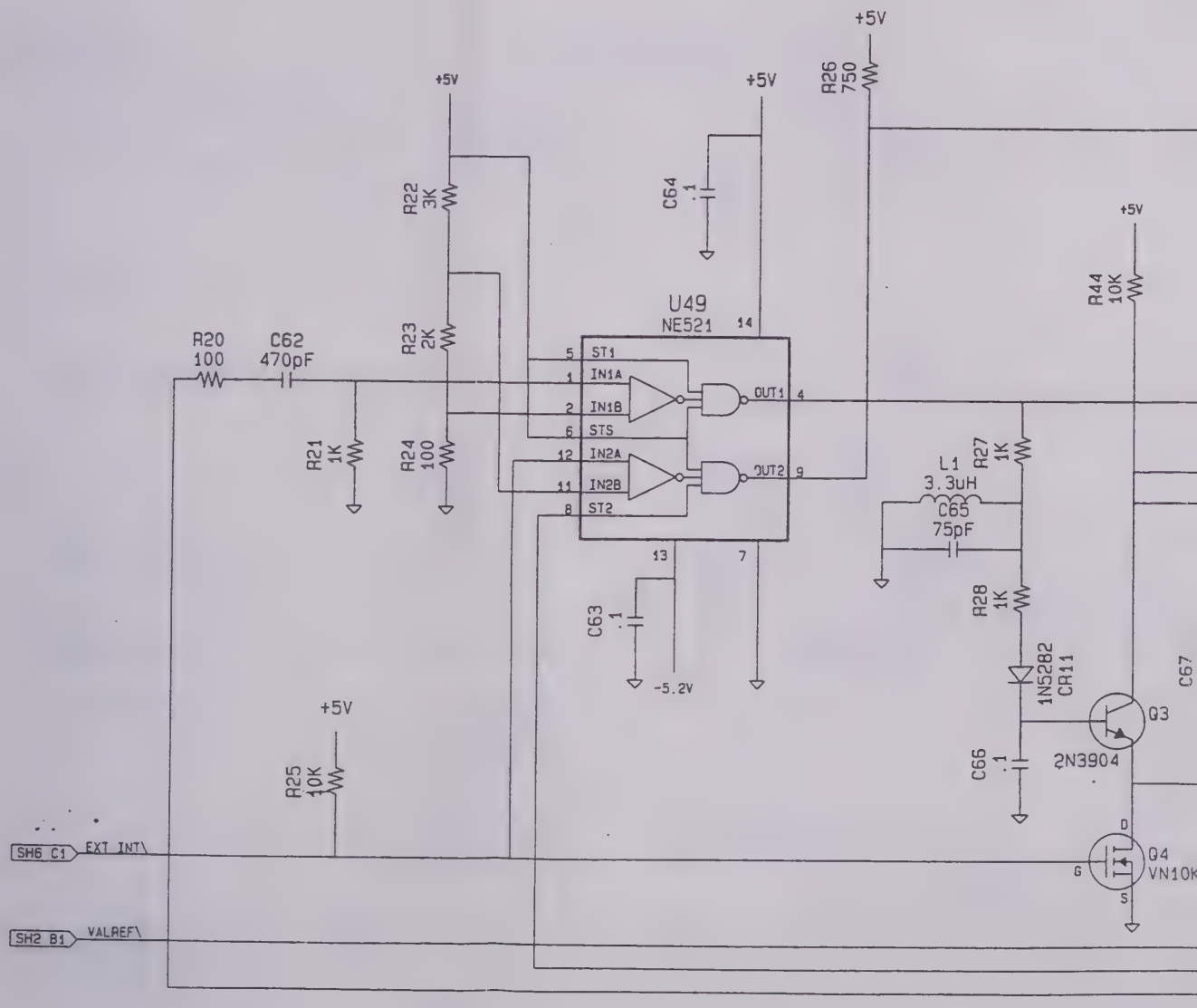
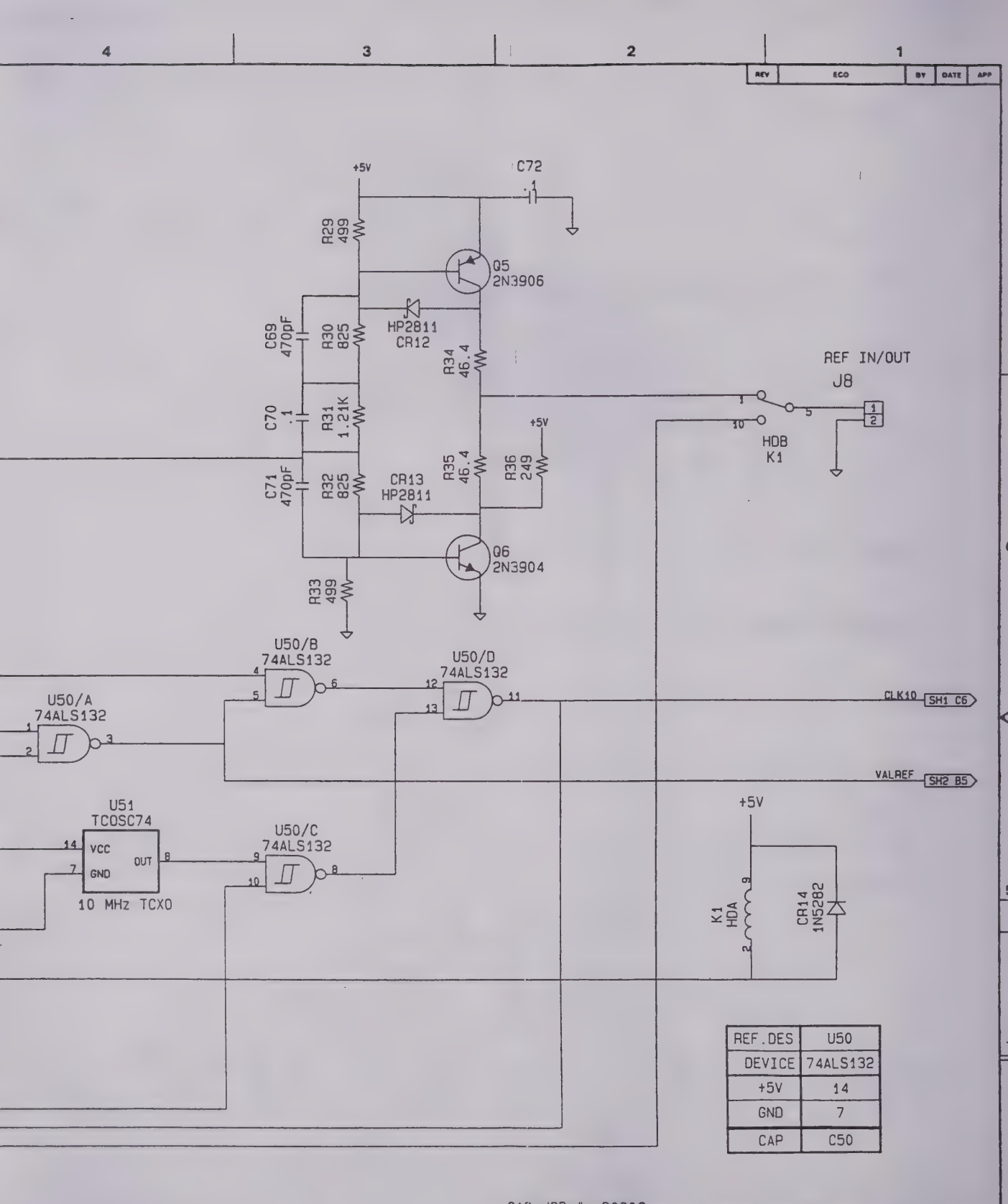
REFERENCE IN/OUT



NOTE UNLESS OTHERWISE SPECIFIED



REF.DES	U50
DEVICE	74ALS132
+5V	14
GND	7
CAP	C50

CAD JOB #: 80806

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH WAVETEK PROCESS

DRAWN E.M. Calnan DATE 29-Sep-89

CHECKED E.M. Calnan 29 Sep 89

PROJ ENGR.

RELEASE APPROV.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX ± .XXX ±

DO NOT SCALE DRAWING

WAVETEK SAN DIEGO, CALIFORNIA

TITLE

SCHEMATIC
PROCESSOR BOARD

SIZE D | FSCM NO. 23338 | DWG. NO. 1104-00-3497 | REV C

SCALE NONE | MODEL 235 | SHEET 9 OF 9

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
REF	A/D 295 BACKPLANE	1101-00-3514	WVTK	1101-00-3514	1
REF	SCHEMATIC 295 BACKPLANE	1104-00-3514	WVTK	1104-00-3514	1
1	PCB,BACKPLANE-295 (PANELIZED 2X) REF: SPEC 0008-00-0455 REV E	1700-00-3514	WVTK	1700-00-3514	1
J1 J2 J3 J4 J5	CONN,DIN,F, 96 PIN,A/B/C	20-8457-096-001-097	ELCO	2100-02-0235	5
J6	CONN,HEADER,LOCKING,ST,SQ. PIN	26-60-4160	MOLEX	2100-02-0300	1
2	SUPPORT,LOCKING,CIRCUIT BD(NYLON)	LCBS2-10	RICH	2800-12-0061	8
R1 R8	RES,SMD,200PPM,1%,1/8W,49.9ohm	CRCW1206-49.9FT	DALE	4703-13-4999	2
R11 R13 R2 R4 R6 R9	RES, SMD GP 1/8 LONG 200PPM 5% 160 OHM	MCR18EZHJW161	ROHM	4703-20-1615	6
R10 R12 R14 R3 R5 R7	RES, SMD GP 1/8 LONG 200PPM 5% 240 OHM	MCR18EZH241JW5%	ROHM	4703-20-2415	6
V1	DIODE, VARISTOR	V56ZA8	GE	4899-00-0045	1

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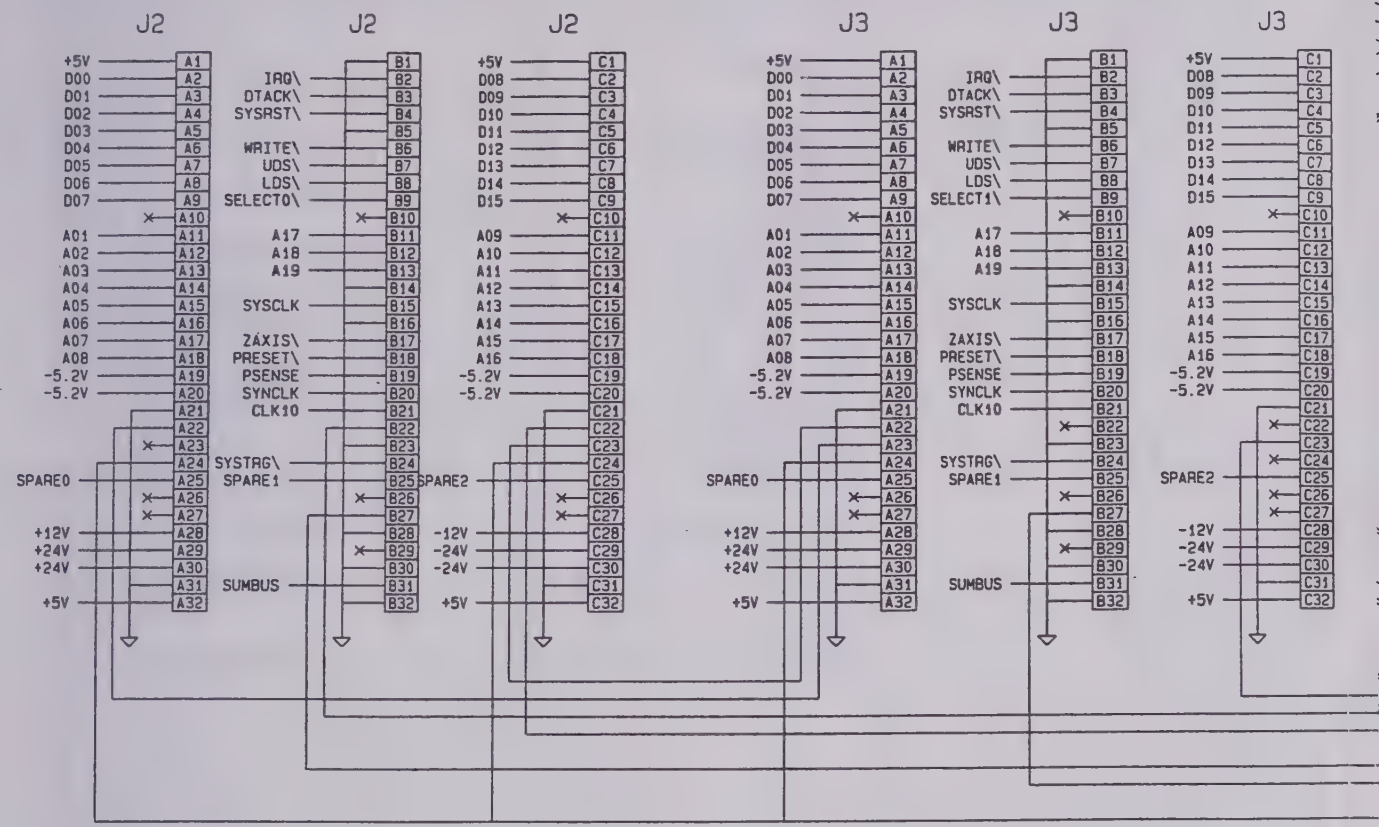
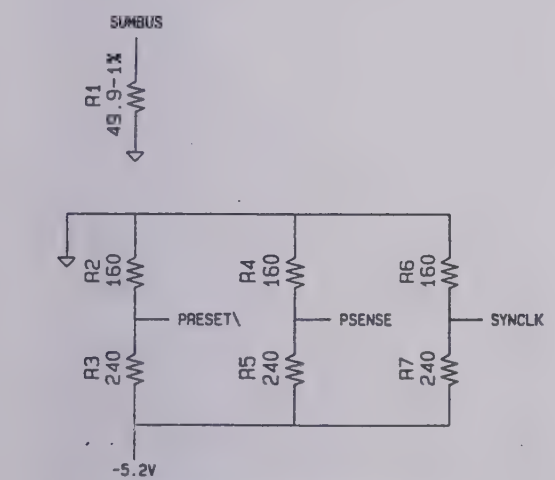
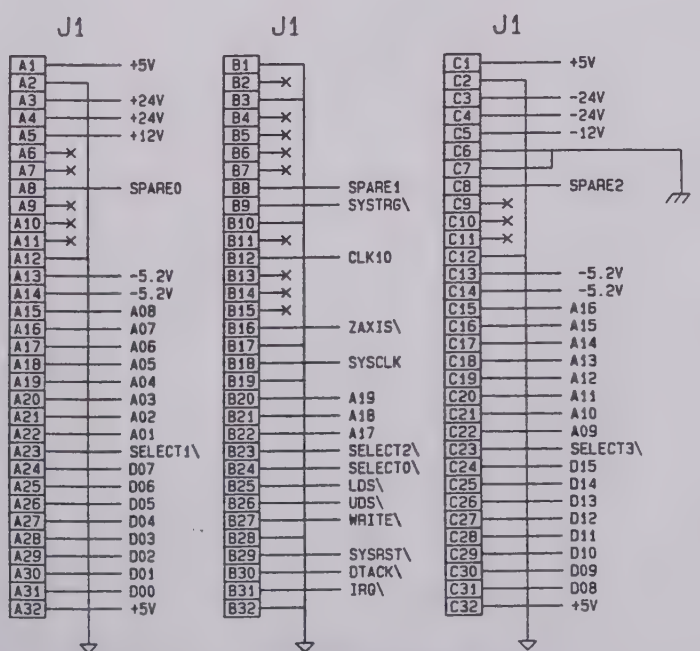




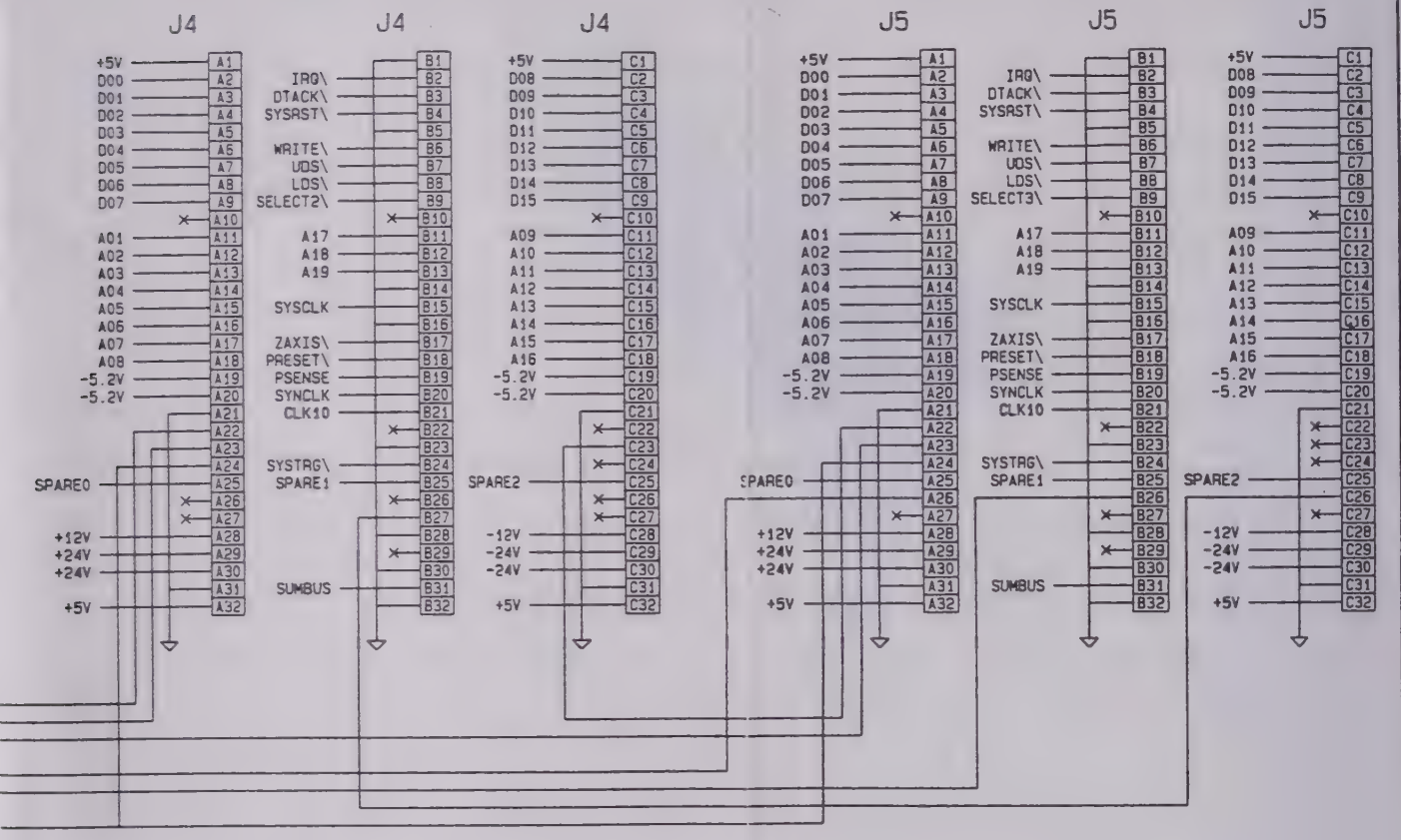


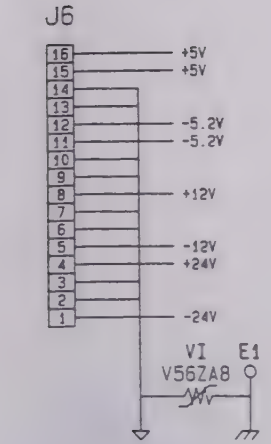
NOTE: J1 IS A MIRROR IMAGE OF PROCESSOR BD P1 (I.E., P1A1 PLUGS INTO J1A32)

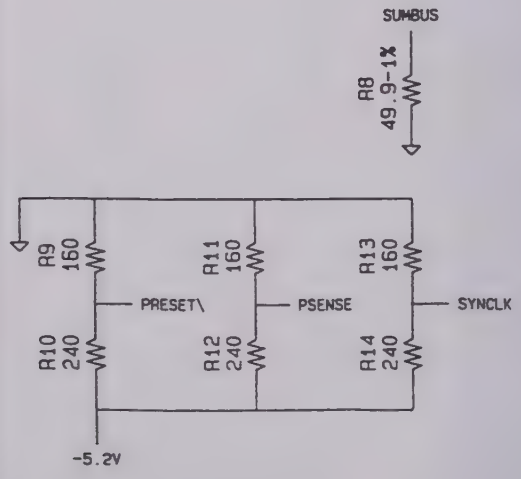
6. ELECTRICAL COMPONENT REFERENCE DESIGNATION STATUS:
   A. LAST USED: J6, R14, V1.
   B. NOT USED: --
5. N SUFFIX TO REFERENCE DESIGNATORS INDICATES NOMINAL VALUE.
4. CAPACITORS VALUED IN MICROFARADS (uF) WITH CERAMIC COMPOSITION; POLARIZED CAPACITORS WITH ALUMINUM ELECTROLYTIC COMPOSITION.
3. RESISTORS VALUED IN OHMS, 1/8W, 1%.
2. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
1. FOR INSTRUMENT INTERCONNECTION, SEE INSTRUMENT SCHEMATIC, 1004-00-0675

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-274			


J4
+5V D00 D01 D02 D03 D04 D05 D06 D07
A01 A02 A03 A04 A05 A06 A07 A08
-5.2V -5.2V
SPARE0
+12V +24V +24V
+5V
IRQ\ DTACK\ SYSRST\ WRITE\ UDS\ LDS\ SELECT2\
A17 A18 A19 SYSCLK ZAXIS\ PRESET\ PSENSE SYNCLK CLK10 SYSTAG\ SPARE1
SUMBUS
J4
+5V D08 D09 D10 D11 D12 D13 D14 D15
A09 A10 A11 A12 A13 A14 A15 A16
-5.2V -5.2V
SPARE2
-12V -24V -24V
+5V
J5
+5V D00 D01 D02 D03 D04 D05 D06 D07
A01 A02 A03 A04 A05 A06 A07 A08
-5.2V -5.2V
SPARE0
+12V +24V +24V
+5V
J5
IRQ\ DTACK\ SYSRST\ WRITE\ UDS\ LDS\ SELECT3\
A17 A18 A19 SYSCLK ZAXIS\ PRESET\ PSENSE SYNCLK CLK10 SYSTAG\ SPARE1
SUMBUS
J5
+5V D08 D09 D10 D11 D12 D13 D14 D15
A09 A10 A11 A12 A13 A14 A15 A16
-5.2V -5.2V
SPARE2
-12V -24V -24V
+5V





CAD JOB #B083A

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M.Calnan	DATE
MATERIAL	CHECKED	
	PROJ. ENGR. RBG	7/14/92
FINISH WAVETEK PROCESS	RELEASE APPROV RBG	7/14/92
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE. FRACTIONS DECIMALS ANGLES .XX ±.01 .XXX ±.005	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: SCHEMATIC, BACKPLANE

SIZE	FSCM NO.	DWG NO.	REV
D	23338	1104-00-3514	A

SCALE NONE | MODEL 235 | SHEET 1 OF 1

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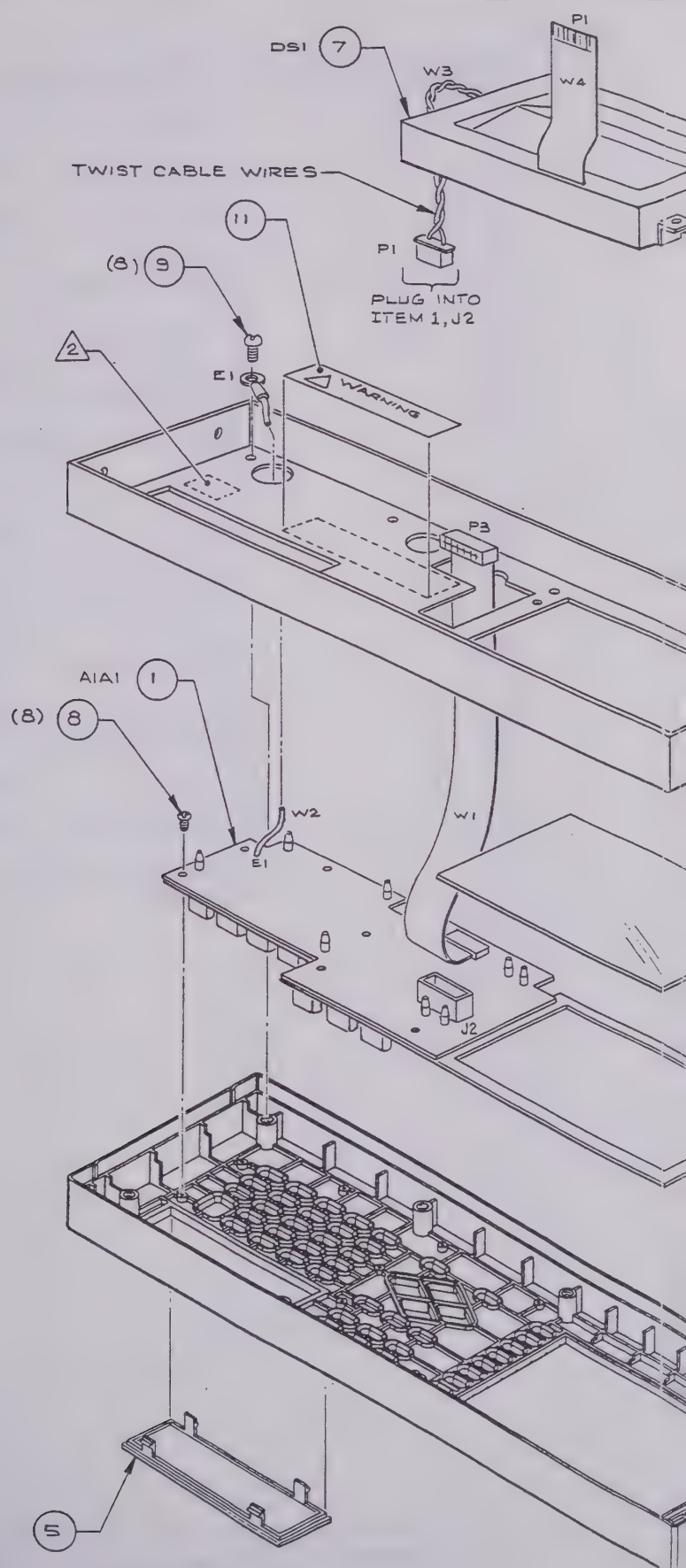


4. DRAWING CONFIGURATION IS APPLICABLE FOR ALL DASH NUMBER CONFIGURATIONS.

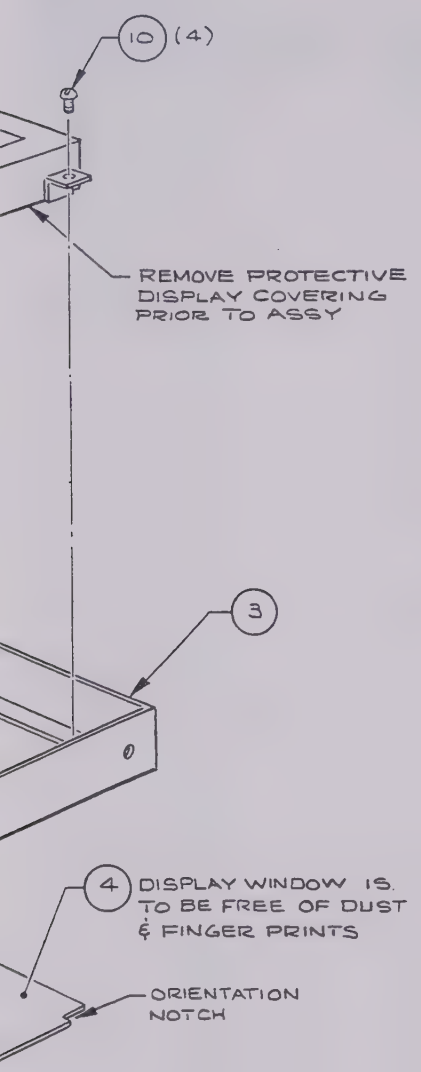
3. PARTIAL REFERENCE DESIGNATIONS SHOWN. PREFIX WITH ASSEMBLY REFERENCE DESIGNATION A1.

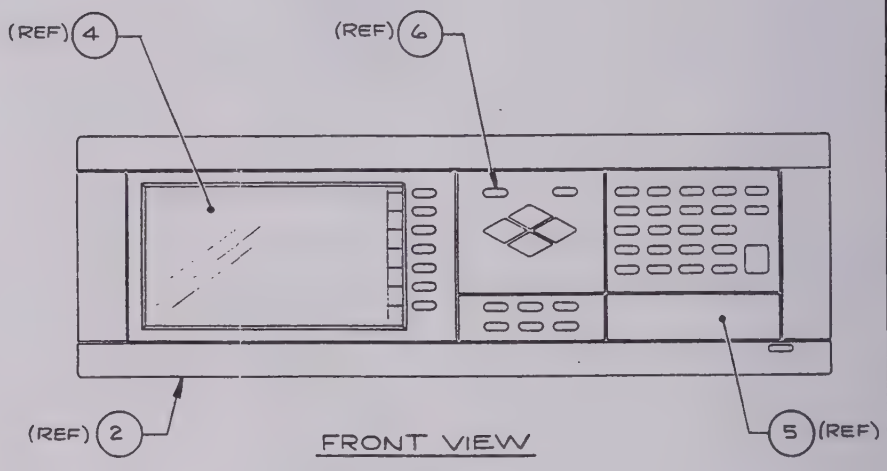
2. MARK ASSEMBLY WITH PART NUMBER, REVISION LEVEL, DATE CODE AND SEQUENCE NUMBER (OPTIONAL) IN APPROXIMATE AREA SHOWN.

1. ASSEMBLE PER WAVETEK WORKMANSHIP STANDARDS.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-212	B.R.	4/6/92	R.S.





FRONT VIEW

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: B. REDMAN	DATE: 4/1/92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL: —	CHECKED: [signature]	4-6-92	TITLE: ASSEMBLY, FRONT PANEL
	PROJ. ENGR: H.J. MAJOR	4-7-92	
FINISH: WAVETEX PROCESS —	RELEASE APPROV: RSG	4-7-92	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±		SIZE D · FSCM NO. 23338 · DWG NO 1101-00-3533 · REV A · SCALE NONE · MODEL 235 · SHEET 1 OF 1

ECO-92-1011

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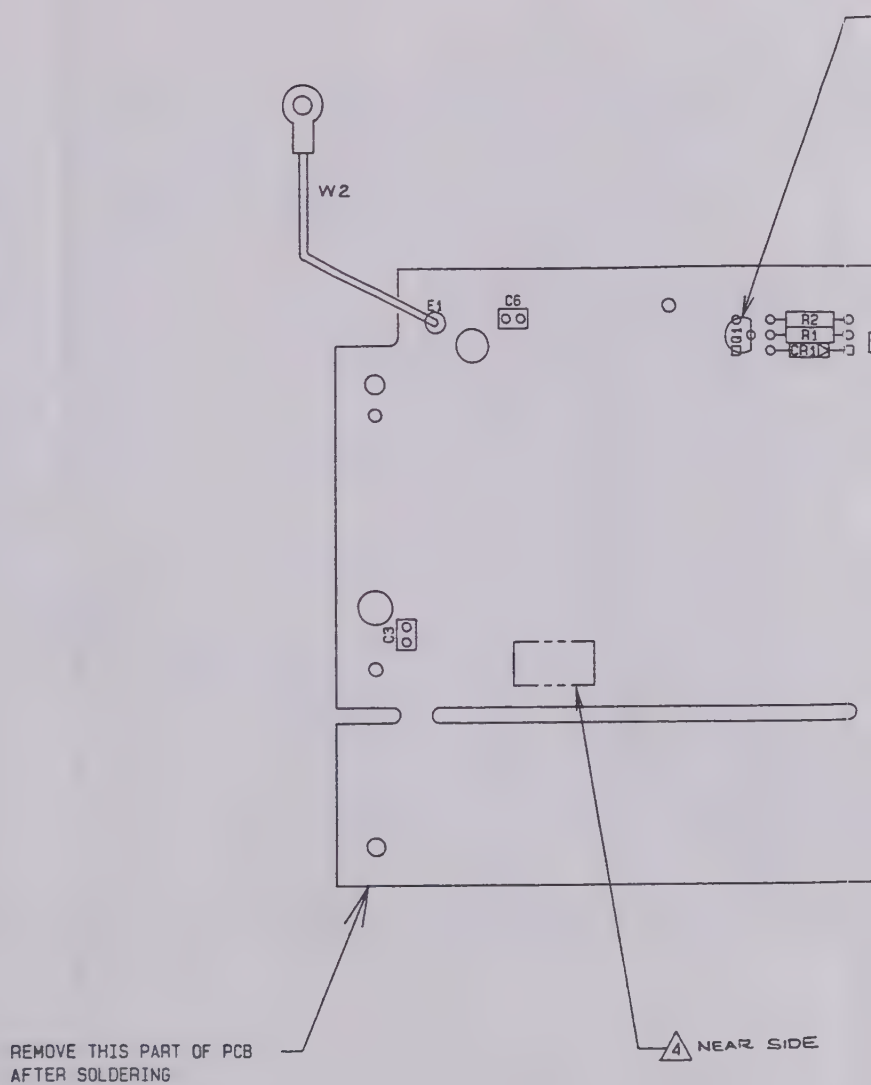
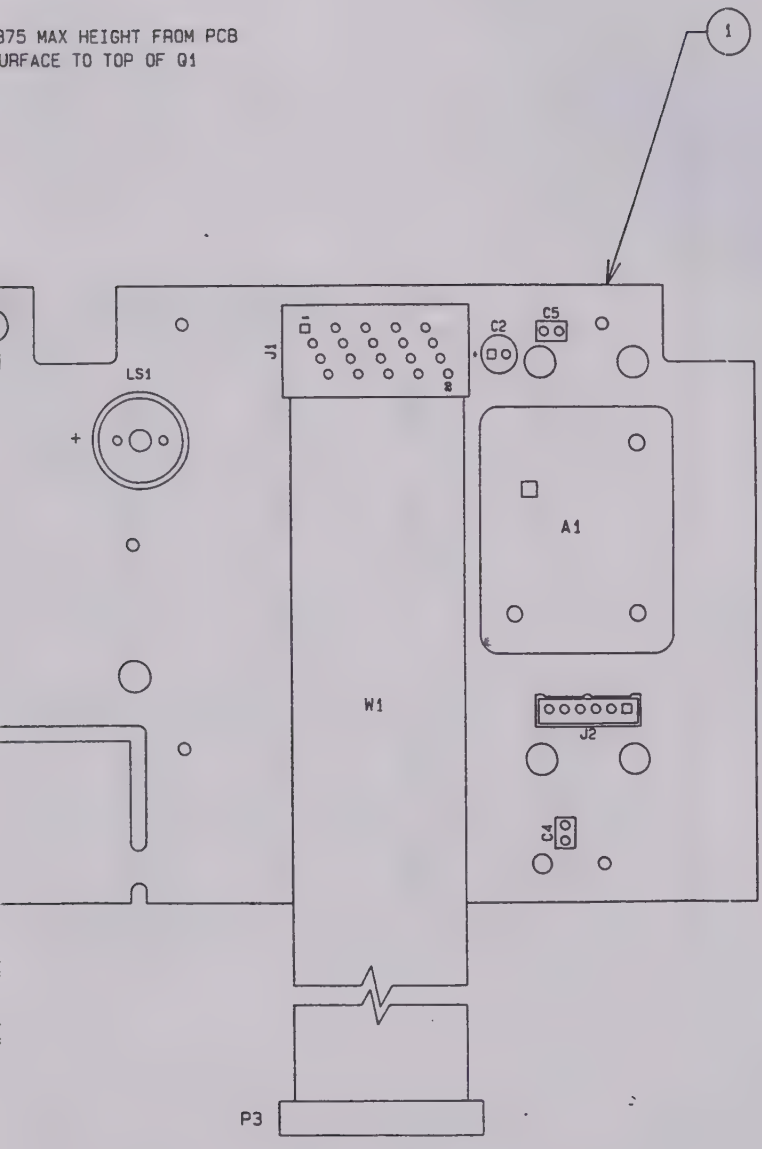


7. ALL PARTS ARE INSTALLED ON NEARSIDE OF PCB.
6. DRAWING CONTENT IS APPLICABLE TO ALL DASH NUMBER CONFIGURATIONS.
5. PARTIAL REFERENCE DESIGNATIONS SHOWN. PREFIX WITH ASSY REF DES A1A1.
4. MARK ASSY WITH PART NUMBER, REVISION LEVEL, DATE CODE, AND SEQUENCE NUMBER (OPTIONAL) IN APPROX. AREA SHOWN.
3. ASSEMBLE PER WAVETEK WORKMANSHIP STANDARDS.
2. FOR ASSY INTERCONNECTION, SEE INSTRUMENT SCHEMATIC 1004-00-0675.
1. SEE 1104-00-3473 FOR SCHEMATIC.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-274	BR	6-8-92	RJG

.875 MAX HEIGHT FROM PCB
SURFACE TO TOP OF Q1



CAD JOB #: R0818

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: BD FIFER	DATE: 2/5/92
MATERIAL	CHECKED:	6/8/92
	PROJ. ENGR.: RJG	6/8/92
FINISH: WAVETEK PROCESS	RELEASE APPROV.: RJG	6/8/92
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ±	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PCA, KEYPAD BOARD

SIZE	FSCM NO.	DWG. NO.	REV
D	23338	1201-00-3473	A

SCALE NONE | MODEL 295 | SHEET 1 OF 1

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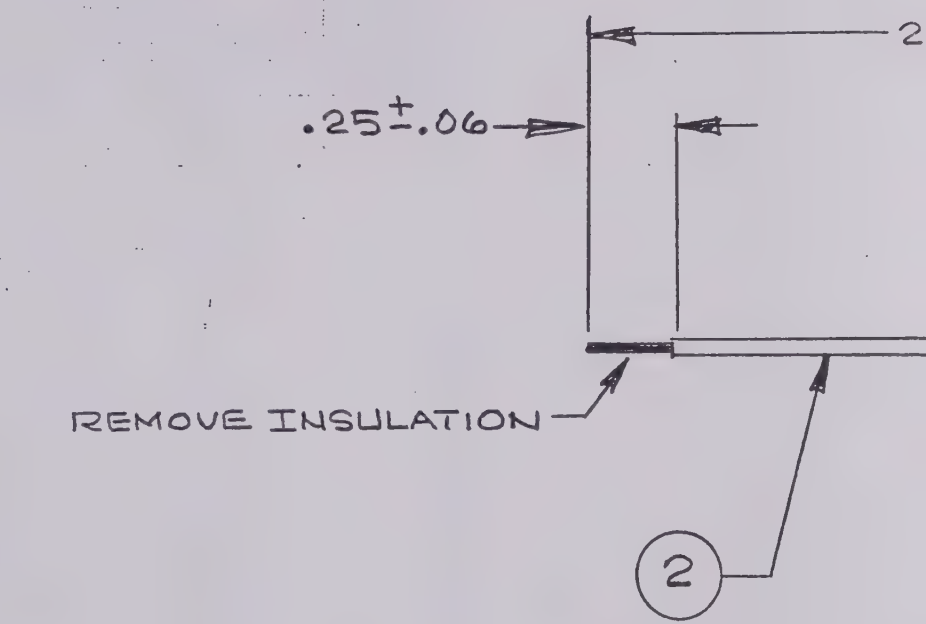
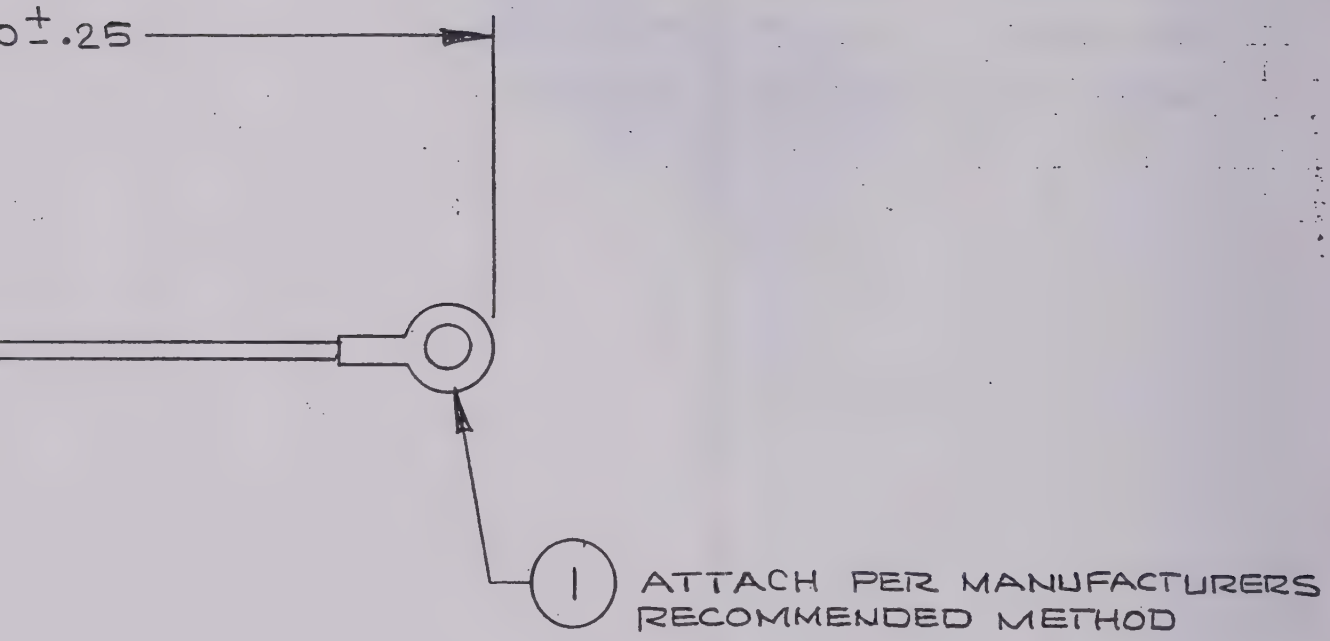


1. PERMANENTLY MARK ASSEMBLY WITH ASSEMBLY NUMBER, REVISION AND DATE CODE PER MIL-STD-130

NOTE: UNLESS OTHERWISE SPECIFIED

137088

REV	ECO	BY	DATE	APP
A	ERO NO. 92-191	B.R.	3/23/92	RBG



SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN B. REDMAN	DATE 2/18/92	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL —	CHECKED S.S. Chamala	3-23-92	TITLE ASSEMBLY- WIRE, CHASSIS GND
	PROJ. ENGR. H.J. MALAN	3-24-92	
	RELEASE APPROV. RBG	3-23-92	
FINISH WAVETEK PROCESS —	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± ±		
DO NOT SCALE DRAWING			SIZE B | FSCM NO. 23338 | DWG. NO. 1201-00-3623 | REV A
			SCALE NONE | MODEL 295 | SHEET 1 OF 1

D C B A

2 1

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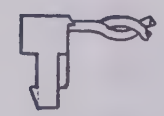
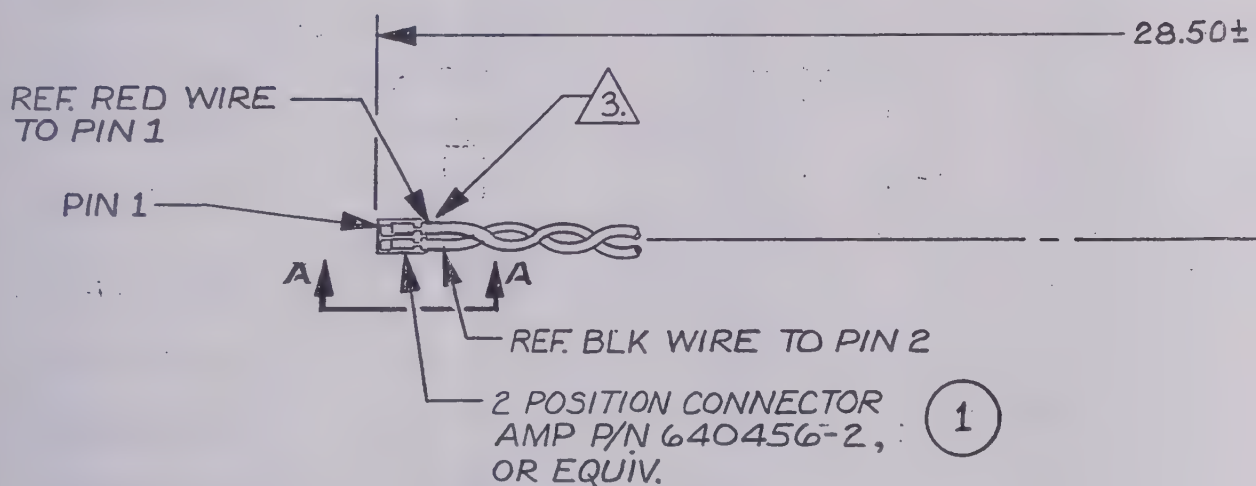
TABULATION

CONN. NO.	CABLE A
W4 P7	1200-00
W5 P8	1200-00
W6 P5	1200-0
W7 P6	1200-0

3.



VIEW **A-A**



6. INSTALL CONNECTORS PER MANUFACTURERS RECOMMENDED METHOD.

5. PERMANENTLY MARK CABLE ASSEMBLY AT BNC END WITH "BNC NO." WHICH CORRESPONDS TO "CABLE ASSY P/N" PER MIL-STD-130 REF. TABULA

4. PERMANENTLY MARK INDIVIDUAL CABLE ASSY'S WITH "CABLE ASSY P/N", REV. AND DATE CODE PER MIL-STD-130. REF. TABULATION CHART.

3. PERMANENTLY MARK CONNECTORS WITH CONN. NO. WHICH CORRESPONDS TO "CABLE ASSY P/N" PER MIL-STD-130. REF. TABULATION CHART.

2. TWIST WIRES APPROX. 2 TURNS PER LINEAR INCH.

1. LEAVE HEX NUT AND WASHER OFF ASSY. AND DELIVER THEM IN BAG SEPARATE FROM CABLE ASSY'S.

NOTE: UNLESS OTHERWISE SPECIFIED

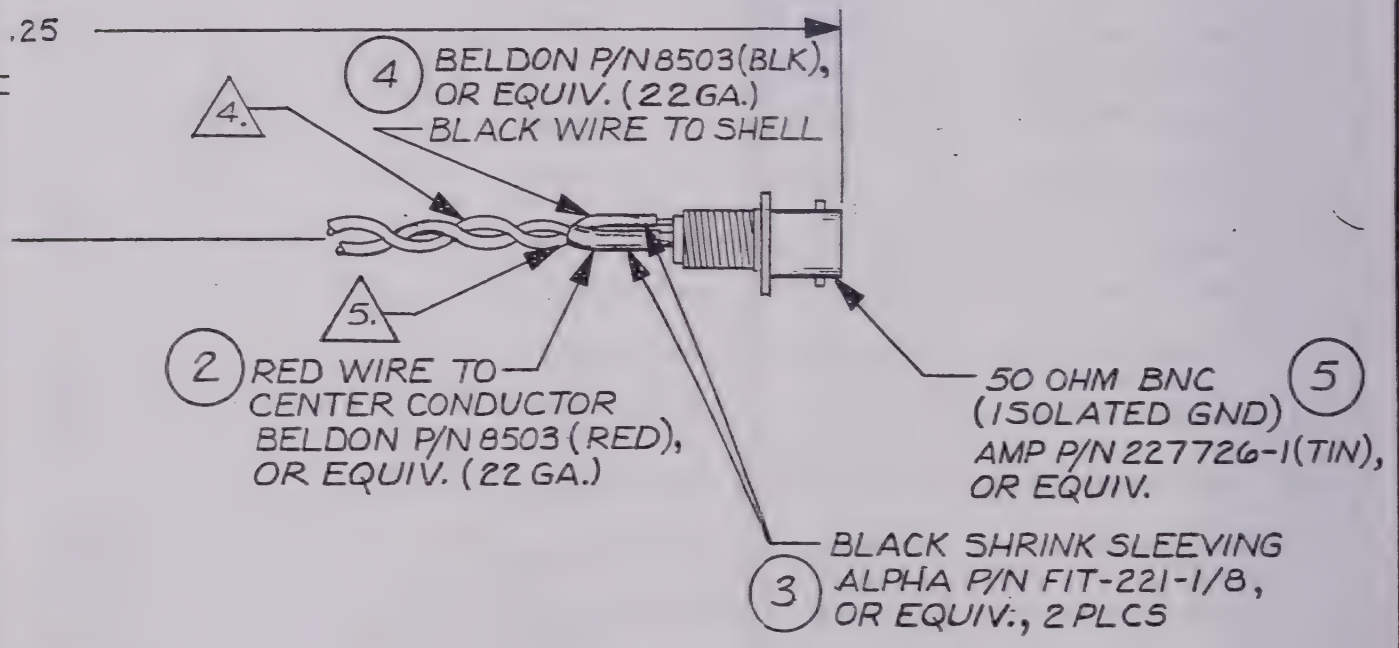
137068

REV	ECO	BY	DATE	APP
A	ERO 92-191	SC	3-20-92	RBG

J CHART

ASSY P/N	BNC NO.
)-3560-01	W4J7
O-3560-02	W5J8
O-3560-03	W6J5
O-3560-04	W7J6

4. 5.


.25
4
BELDON P/N 8503 (BLK), OR EQUIV. (22 GA.)
BLACK WIRE TO SHELL
4.
5.
2
RED WIRE TO CENTER CONDUCTOR BELDON P/N 8503 (RED), OR EQUIV. (22 GA.)
50 OHM BNC (ISOLATED GND) AMP P/N 227726-1 (TIN), OR EQUIV.
5
BLACK SHRINK SLEEVING ALPHA P/N FIT-221-1/8, OR EQUIV., 2 PLCS
3

TION CHART.

SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH
WAVETEK PROCESS

DO NOT SCALE DRAWING

DRAWN	CHERMACK	8-1-91
CHECKED	B. REDMAN	3/23/92
PROJ. ENGR.	H. J. MALKIN	3-24-92
RELEASE APPROV.	RBG	3-24-92

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
~~FRACTIONS~~ ~~DECIMALS~~ ~~ANGLES~~
± .XX ± ±
.XXX ±

WAVETEK SAN DIEGO • CALIFORNIA

TITLE

KIT, CABLE, SYSTEM BNC
(W4 THRU W8)

SIZE	FSCM NO.	DWG. NO.	REV
B	23338	1101-00-3560	A

SCALE FULL | MODEL 295 | SHEET 1 OF 1

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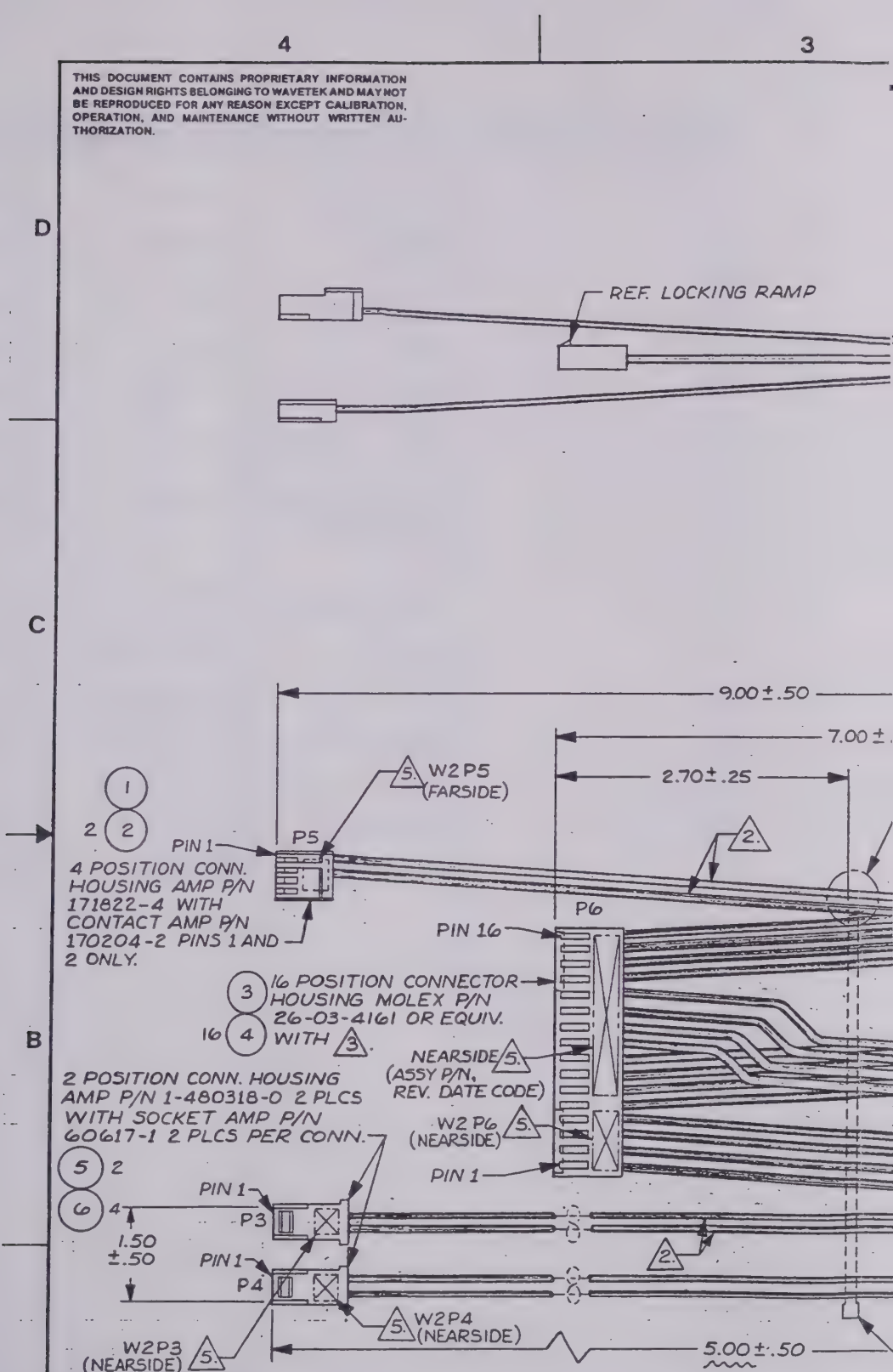


5. PERMANENTLY MARK CONNECTOR REF. DESIGNATORS AND ASSEMBLY P/N DATE CODE PER MIL-STD-130. WHEN MARKING ON CONNECTOR HOUSING OBSE CONNECTOR DESIGNATED FOR MARKING.

4. USE OF EQUIVALENT PARTS IS ACCEPTABLE.

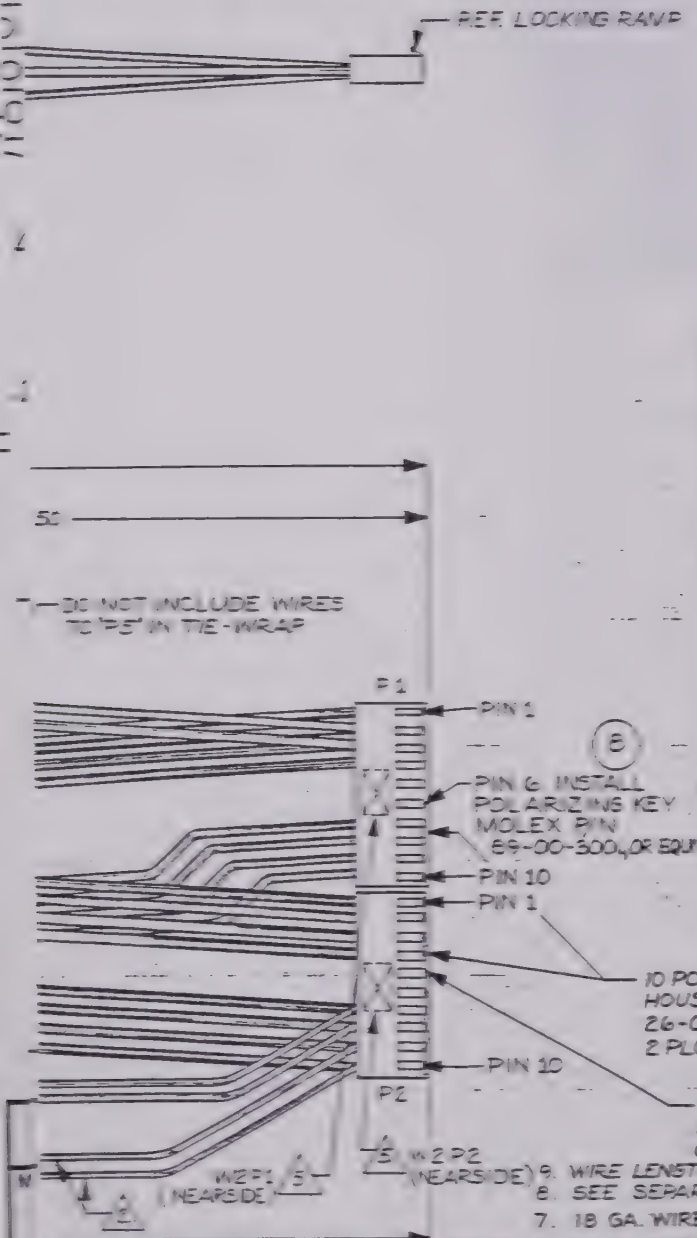
3. USE CRIMP TERMINAL MOLEX P/N 08-50-0187, OR EQUIV.

2. TWISTED PAIR (APPROX. 2 TURNS PER LINEAR INCH).

1. PREP WIRES AND INSTALL ALL ITEMS PER MANUFACTURERS RECOMMEN

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-191	SC	3-20-92	RBG


REF. LOCKING RAMP
50
DO NOT INCLUDE WIRES TO "P5" IN TIE-WRAP
P1
PIN 1
PIN 6 INSTALL POLARIZING KEY MOLEX P/N 89-00-300, OR EQUIV.
PIN 10
PIN 1
10 POSITION CONNECTOR HOUSING MOLEX P/N 26-03-4101, OR EQUIV. 2 PLCS WITH
PIN 10
P2
PIN 5 INSTALL POLARIZING KEY MOLEX P/N 89-00-3001, OR EQUIV.
W2 P1, NEARSIDE
W2 P2 (NEARSIDE)
TIE-WRAP, PANDUIT P/N SST1M-M

WIRE HOOKUP LIST

GA.	COLOR	FROM	TO	LG(FT)	ITEM NO.	
22	VIO	P6-1	P2-10	.85	13	
	BLK	-2	-9		14	
	BLK	-3	-8		14	
	GRAY	-4	-7		15	
	BLU	-5	P1-10		16	
	BLK	-6	-9		14	
	BLK	-7	-8		14	
22	ORN	-8	-7		17	
18	BLK	-9	P2-2		10	
	BLK	-10	-1		10	
	YEL	-11	-4		12	
	YEL	-12	-3		12	
	BLK	-13	P1-4		10	
	BLK	-14	-3		10	
	RED	-15	-2		11	
18	RED	P6-16	-1	.85	11	
22	GRAY	P2-7	P3-1	0.5	15	2.
22	WHT	P2-8	P3-2	0.5	18	2.
22	WHT	P2-9	P4-1	0.5	18	2.
22	VIO	P2-10	P4-2	0.5	13	2.
22	RED	P1-2	P5-1	.75	19	2.
22	BLK	P1-3	P5-2	.75	14	2.

NOTES:
6. 22 GA. WIRE IS BELDON P/N 8503 (COLOR), OR EQUIV..
7. 18 GA. WIRE IS BELDON P/N 8501 (COLOR), OR EQUIV..
8. SEE SEPARATE PARTS LIST.
9. WIRE LENGTHS LISTED IN WIRE HOOKUP LIST ARE APPROXIMATE.

DED METHOD.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 8-7-91	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED B. REDMAN	8/23/92	TITLE: ASSEMBLY, CABLE, POWER SUPPLY
	PROJ. ENGR. H. J. MALAN	3 24 92	
	RELEASE APPROV. R.B.S	3/24/92	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX ± .03 .XXX ±		
DO NOT SCALE DRAWING			SIZE C | FSCM NO. 23338 | DWG. NO. 1201-00-3525 | REV A
			SCALE FULL | MODEL 295 | SHEET 1 OF 1

1201-00-3525 A

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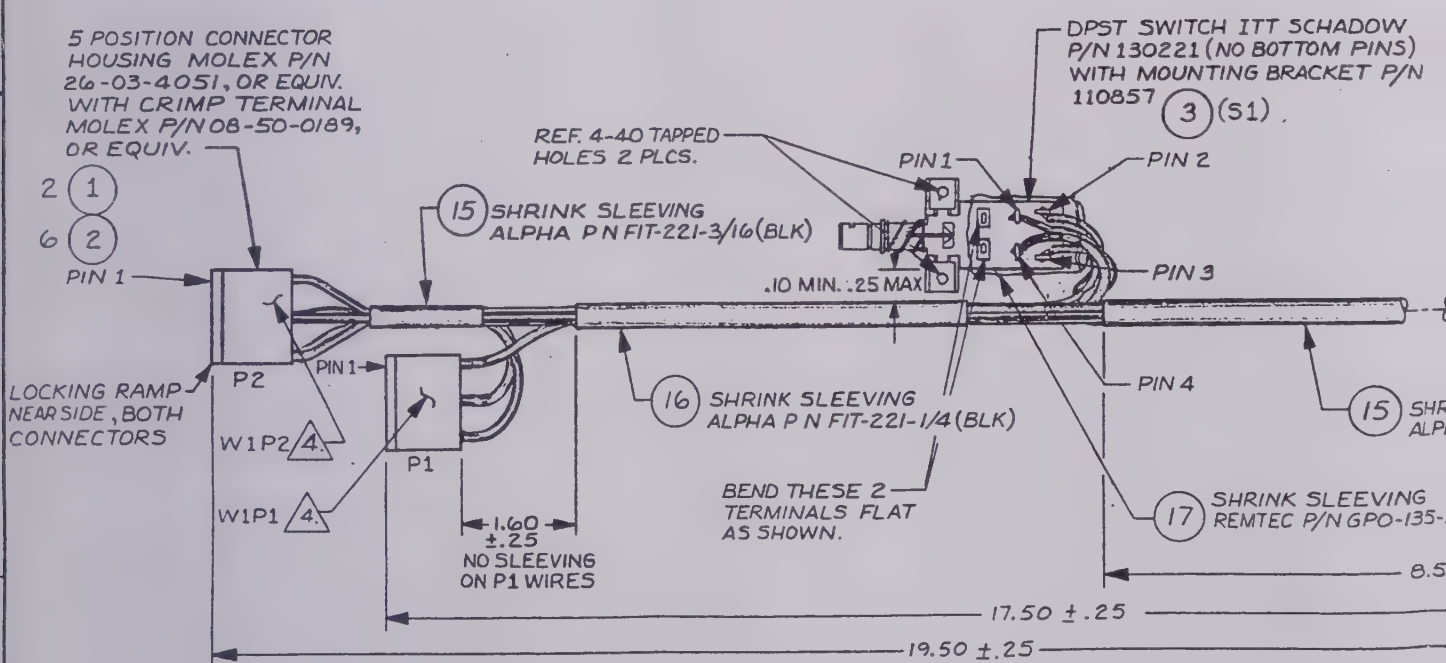
WIRE HOOK UP LIST

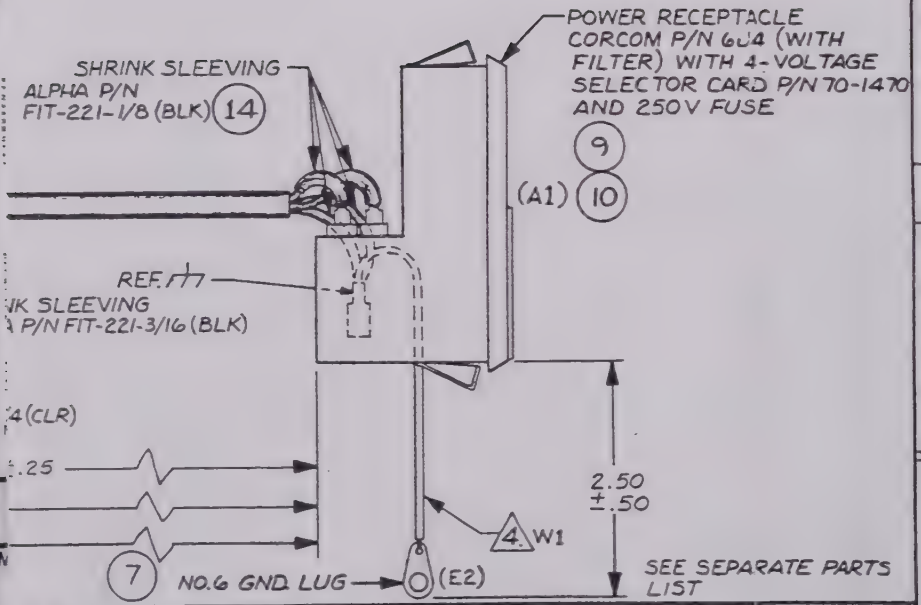
GA.	COLOR	FROM	TO	LG(FT)	ITEM NO.
18	GRN/YEL	A1-⏚	P1-1	1.4'	11
18	GRN/YEL	A1-⏚	P2-1	1.6'	11
18	GRN/YEL	A1-⏚	E2	.4'	11
18	BRN	A1-L	AS1-2	1.0'	13
18	BLU	A1-N	BS1-3	1.0'	12
18	BRN	P2-5	AS1-1	1.2'	13
18	BLU	P2-3	BS1-4	1.2'	12
18	BRN	P2-5	P1-5	.25'	13
18	BLU	P2-3	P1-3	.25'	12


5 POSITION CONNECTOR HOUSING MOLEX P/N 26-03-4051, OR EQUIV. WITH CRIMP TERMINAL MOLEX P/N 08-50-0189, OR EQUIV.
2 1
6 2
PIN 1
DPST SWITCH ITT SCHADOW P/N 130221 (NO BOTTOM PINS) WITH MOUNTING BRACKET P/N 110857 (3) (S1).
REF. 4-40 TAPPED HOLES 2 PLCS.
PIN 1
PIN 2
(15) SHRINK SLEEVING ALPHA P N FIT-221-3/16(BLK)
.10 MIN. .25 MAX
PIN 3
PIN 4
LOCKING RAMP NEAR SIDE, BOTH CONNECTORS
P2
PIN 1
W1P2 (4)
W1P1 (4)
P1
1.60 ±.25
NO SLEEVING ON P1 WIRES
(16) SHRINK SLEEVING ALPHA P N FIT-221-1/4(BLK)
BEND THESE 2 TERMINALS FLAT AS SHOWN.
(17) SHRINK SLEEVING REMTEC P/N GPO-135-
(15) SHR ALP
8.5
17.50 ±.25
19.50 ±.25

6. WIRE LENGTHS LISTED IN WIRE HOOKUP LIST ARE APPROXIMATE.
5. WIRE IS TO BE JUDD P/N H0102003 (COLOR) OR EQUIV.
4. PERMANENTLY MARK CONNECTORS WITH INFORMATION SHOWN PER MIL-STD-130.
3. PERMANENTLY MARK WITH ASSEMBLY NO., REV. AND DATE CODE PER MIL-STD-130.
2. USE OF EQUIVALENT PARTS IS ACCEPTABLE.
1. PREP WIRES AND INSTALL ALL ITEMS PER MANUFACTURERS RECOMMENDED METHOD.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 93-031	SC	1020-92	mm



1201-00-3678 A

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 8-8-91	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	CHECKED M.S. Mulh	11/4/92	TITLE ASSEMBLY, CABLE, A.C. SWITCHING
	PROJ ENGR. RBG	11/6/92	
FINISH WAVETEK PROCESS	RELEASE APPROV. RBG	11/6/92	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± .XXX ± ±		SIZE C | FSCM NO. 23338 | DWG. NO. 1201-00-3678 | REV A
			SCALE FULL | MODEL 295 | SHEET 1 OF 1

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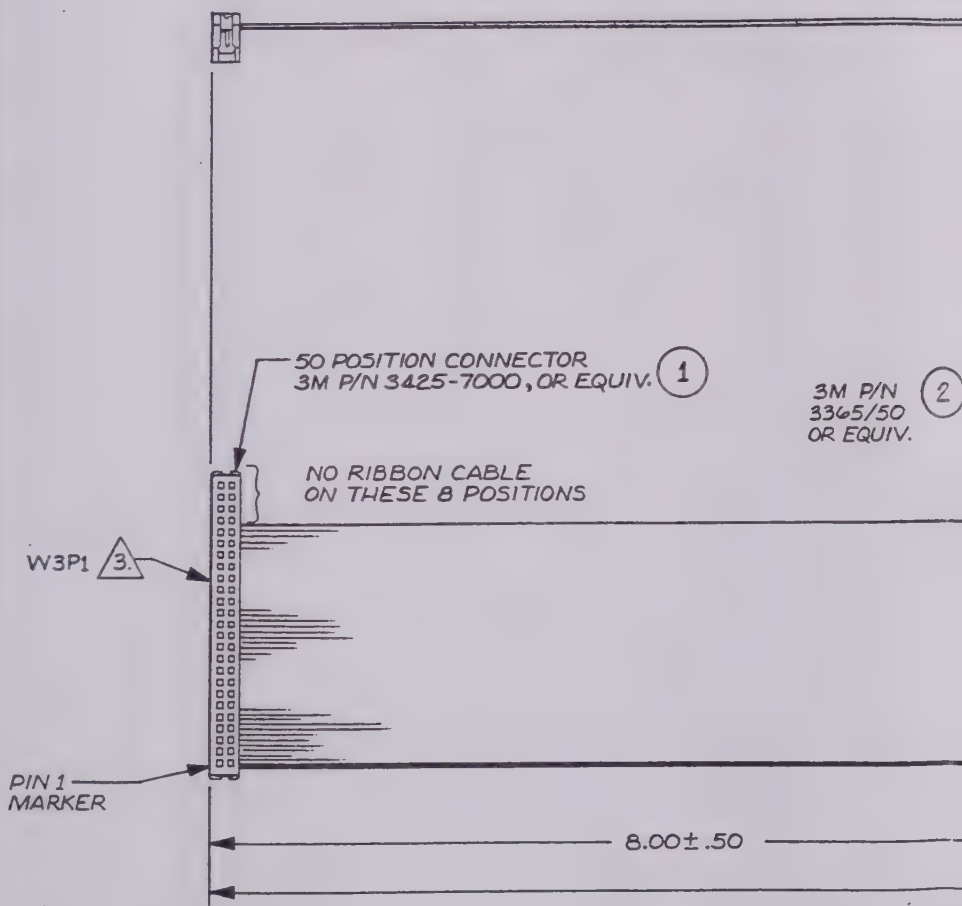
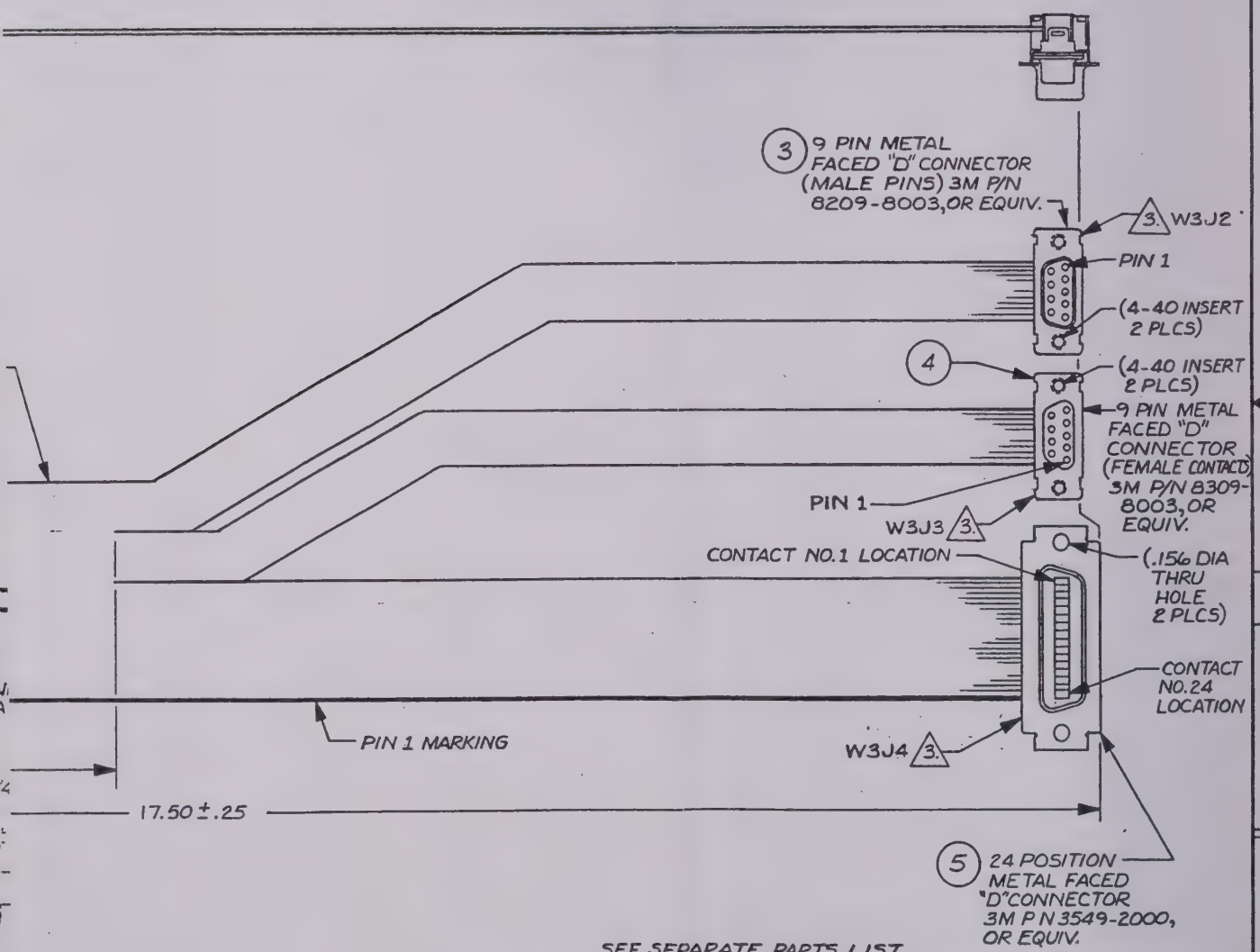


3. PERMANENTLY MARK CONNECTORS WITH INFORMATION SHOWN PER MIL-STD-130.
2. PERMANENTLY MARK WITH ASSY NO., REV., AND DATE CODE PER MIL-STD-130.
1. INSTALL CONNECTORS PER MANUFACTURERS RECOMMENDED METHOD.

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-191	SC	3-20-92	RAL


3 9 PIN METAL FACED "D" CONNECTOR (MALE PINS) 3M P/N 8209-8003, OR EQUIV.
3. W3J2
PIN 1
(4-40 INSERT 2 PLCS)
4
(4-40 INSERT 2 PLCS)
9 PIN METAL FACED "D" CONNECTOR (FEMALE CONTACT) 3M P/N 8309-8003, OR EQUIV.
PIN 1
W3J3 3.
CONTACT NO.1 LOCATION
(.156 DIA THRU HOLE 2 PLCS)
CONTACT NO.24 LOCATION
PIN 1 MARKING
W3J4 3.
17.50 ± .25
5 24 POSITION METAL FACED "D" CONNECTOR 3M P N 3549-2000, OR EQUIV.

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 8-2-91	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED B. REDMAN	8/23/92	TITLE: ASSEMBLY, CABLE, GPIB
	PROJ. ENGR. H.J. MALAN	3-24-92	
FINISH WAVETEK PROCESS	RELEASE APPROV. RAL	9/24/92	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: ~~FRACTIONS~~ ~~DECIMALS~~ ~~ANGLES~~ ± XX ± XXX ± ±		SIZE C | FSCM NO. 23338 | DWG. NO. 1201-00-3527 | REV A
			SCALE FULL | MODEL 295 | SHEET 1 OF 1

1201-00-3527 A

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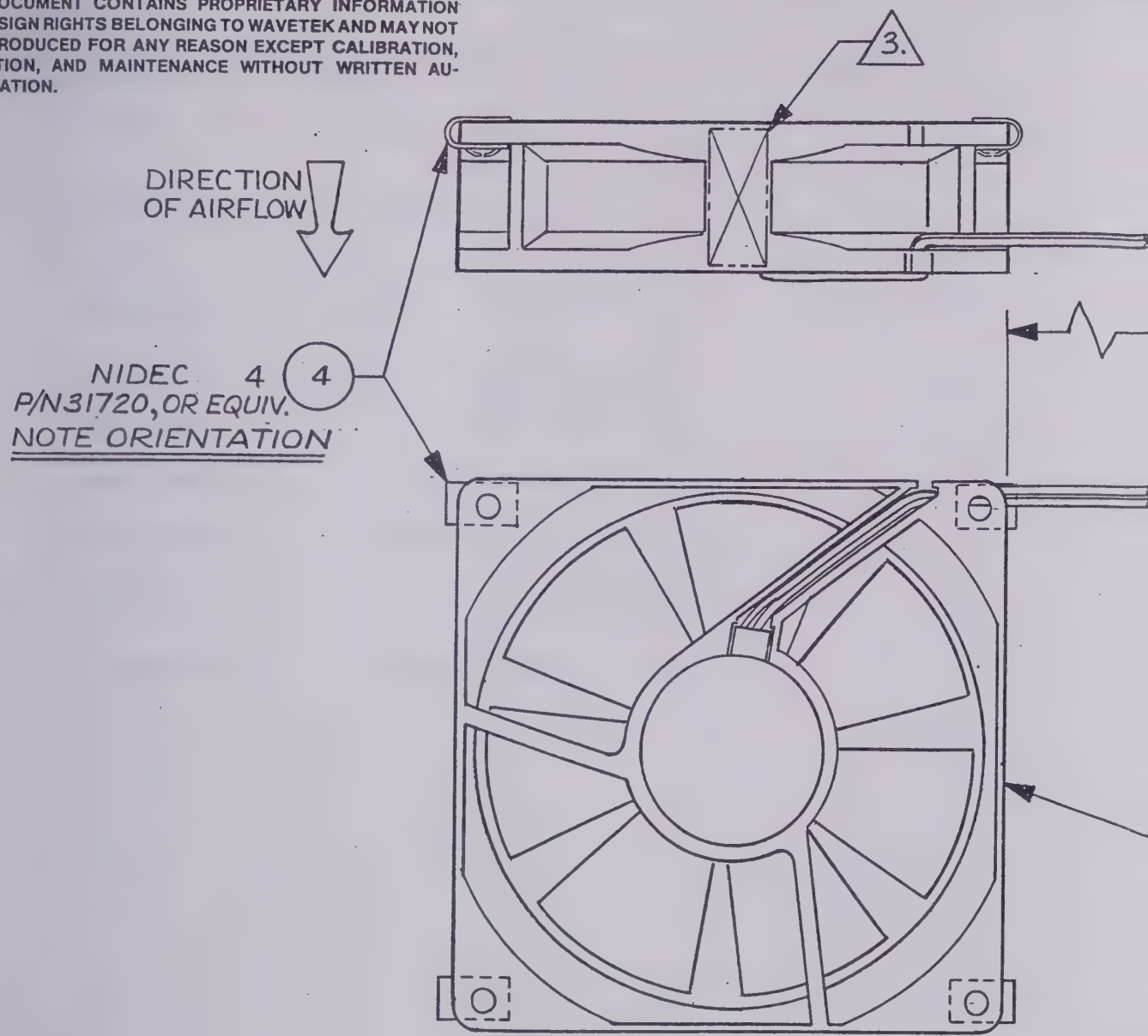


4. PERMANENTLY MARK CONNECTOR WITH INFORMATION SHOWN PER MIL-STD-130.

3. PERMANENTLY MARK WITH ASSY, REV. AND DATE CODE PER MIL-STD-130 IN APPROXIMATE LOCATION SHOWN.

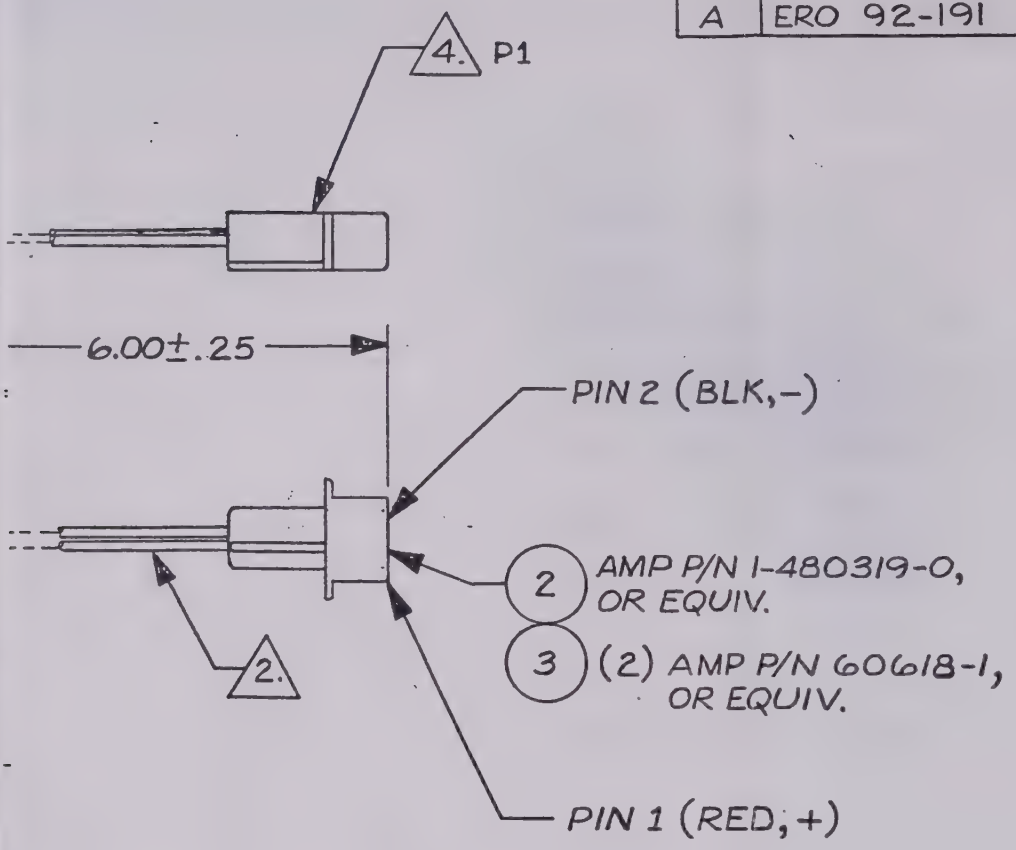
2. TWISTED PAIR (TWIST WIRES AT APPROX. 2 TURNS PER LINEAR INCH).

1. INSTALL CONNECTOR SOCKETS AND HOUSING PER MANUFACTURERS RECOMMENDED METHOD.

NOTE: UNLESS OTHERWISE SPECIFIED

137068

REV	ECO	BY	DATE	APP
A	ERO 92-191	SC	3-20-92	RBG



SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 8-12-91	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	CHECKED B. REDMAN	3/23/92	TITLE: ASSEMBLY, FAN
	PROJ. ENGR. H. J. MALAN	3-24-92	
FINISH WAVETEK PROCESS	RELEASE APPROV. RBG	3-24-92	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: ~~FRACTIONS DECIMALS ANGLES~~ ± .XX ± .XXX ± ±		SIZE B | FSCM NO. 23338 | DWG. NO. 1201-00-3558 | REV A SCALE FULL | MODEL 295 | SHEET 1 OF 1

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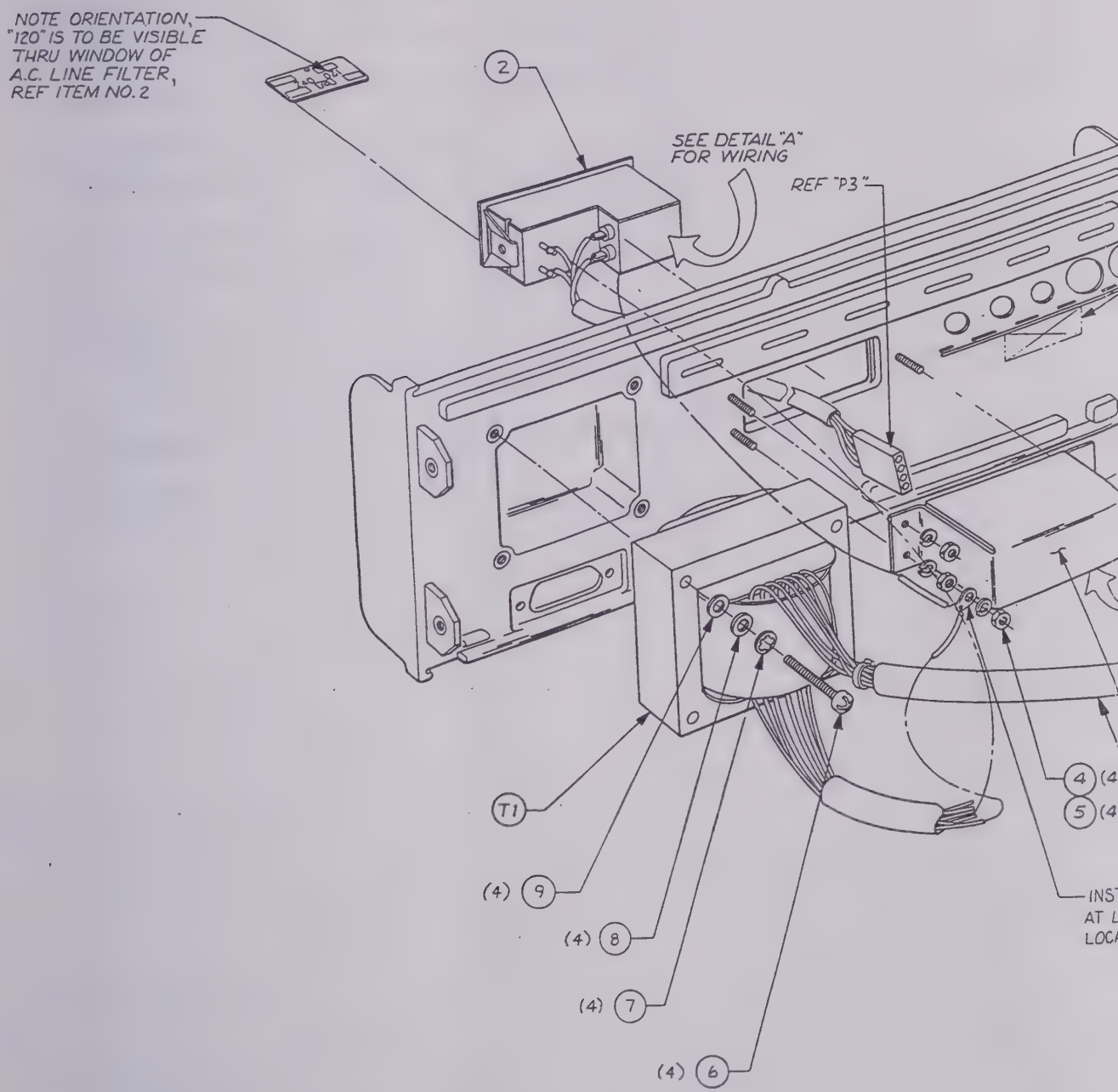
D DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT
REPRODUCED FOR ANY REASON EXCEPT CALIBRATION,
ERATION, AND MAINTENANCE WITHOUT WRITTEN AU-
ORIZATION



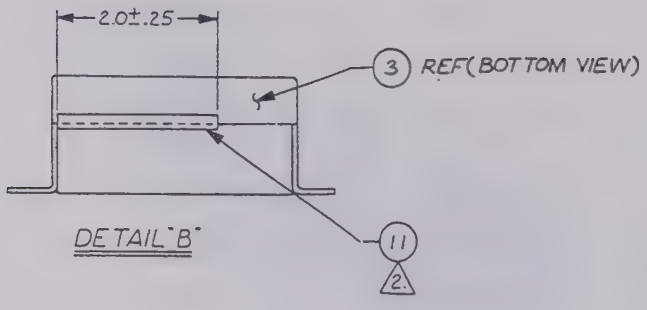
2. INSTALL GROMMET 3200-06-0079 (LESIG PART 924) OR 3200-06-0053 (MINOR RUBBER PART NO. ZX-4064) OR EQUIV. TO SHIELD (ITEM 3) WITH ADHESIVE 1600-03-0013 (LOCTITE PART NO. 414) OR EQUIV.

1. MARK ASSEMBLY NO. "1101-00-3441," LATEST REV, AND DATE CODE , PER-MIL-STD-130, APPROX WHERE SHOWN.

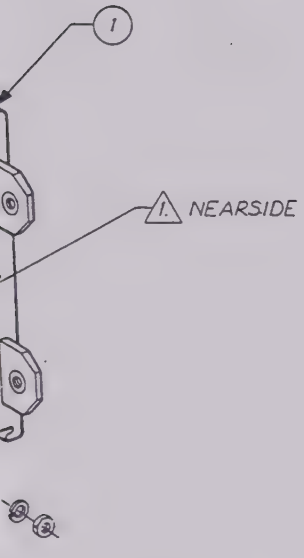
NOTE. UNLESS OTHERWISE SPECIFIED

MODIFIED FROM DWG 1101-00-3325

REV	ECO	BY	DATE	APP
A	ERO NO. 91-328	[illegible]	[illegible]	[illegible]



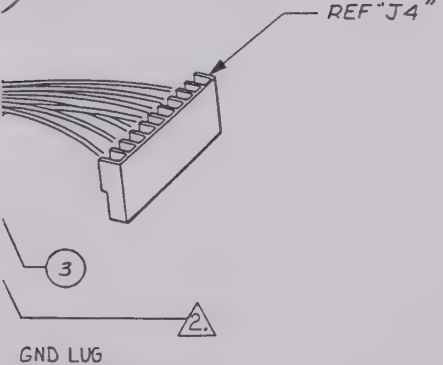
DETAIL "B"



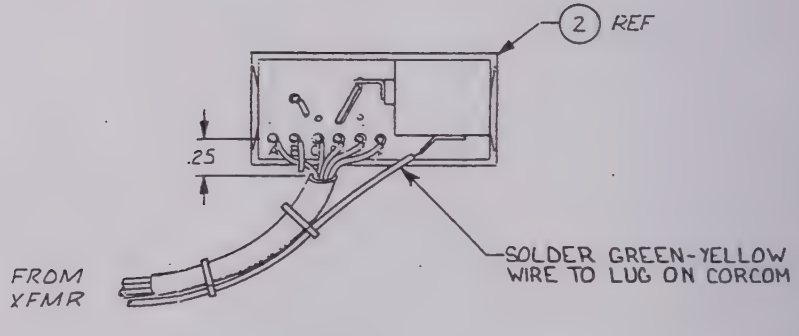
WIRE LIST

XFMR WIRE COLOR	LINE FILTER TERM. MARKING
VIOLET	A
BLACK	C
GRAY	D
WHT/BLK	E
WHT/GRAY	F

SEE DETAIL "B" FOR GROMMET INSTALLATION



GND LUG
R MOUNTING
J.



DETAIL "A"
XFMR WIRE HOOKUP

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RO FIFER	DATE 4-8-91	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL —	CHECKED [signature]	6/20/91	TITLE ASSEMBLY, REAR PANEL
FINISH WAVETEK PROCESS —	PROJ ENGR [signature]	7/12/91	
DO NOT SCALE DRAWING	RELEASE APPROV [signature]	7/12/91	SIZE D; FSCM NO. 23338; DWG NO. 1101-00-3441; REV A
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE. FRACTIONS DECIMALS ANGLES ± XX ± .03 XXX ± .010 ± 1°		SCALE NONE; MODEL 91; SHEET 1 OF 1

1101-00-3441 A

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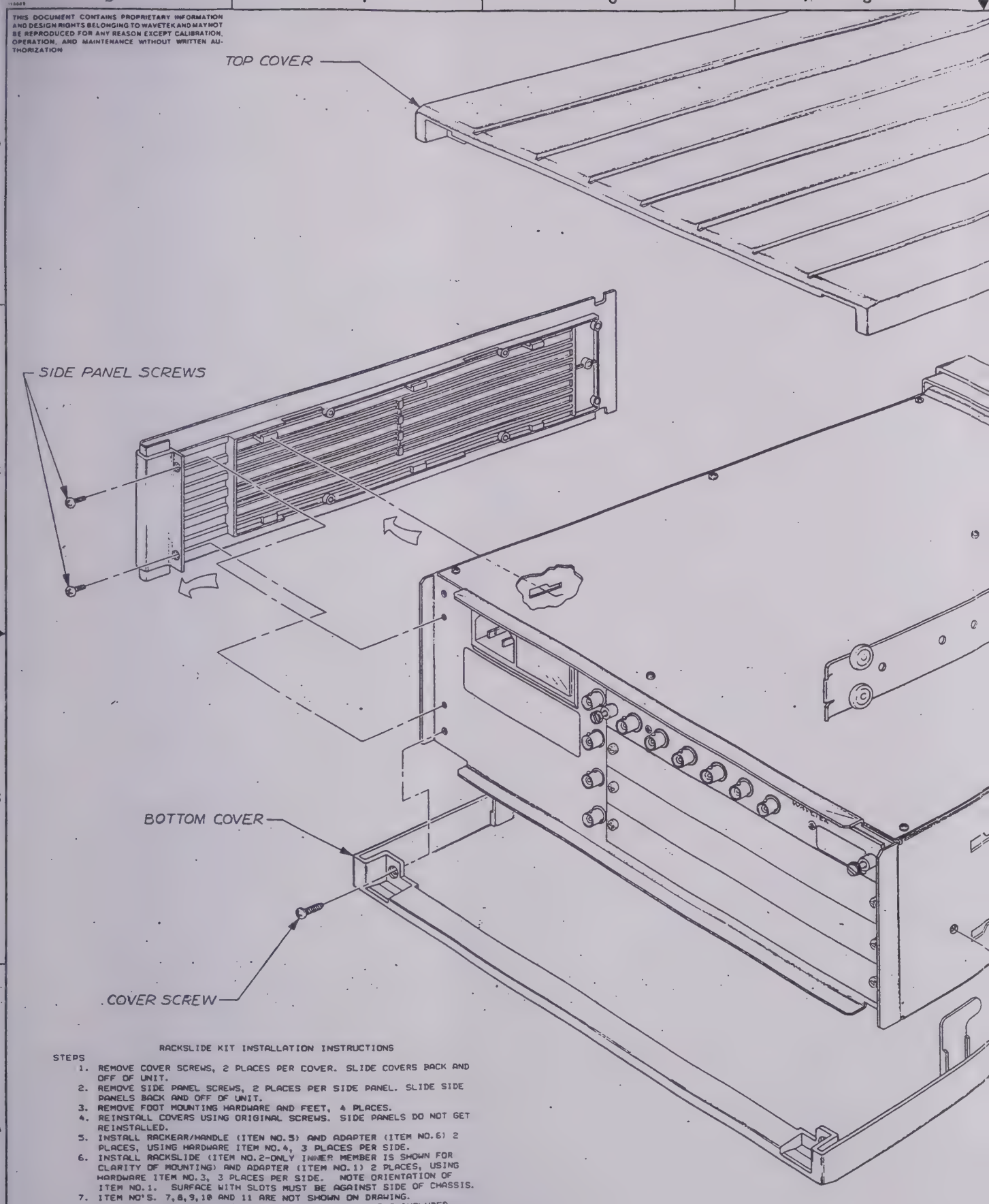


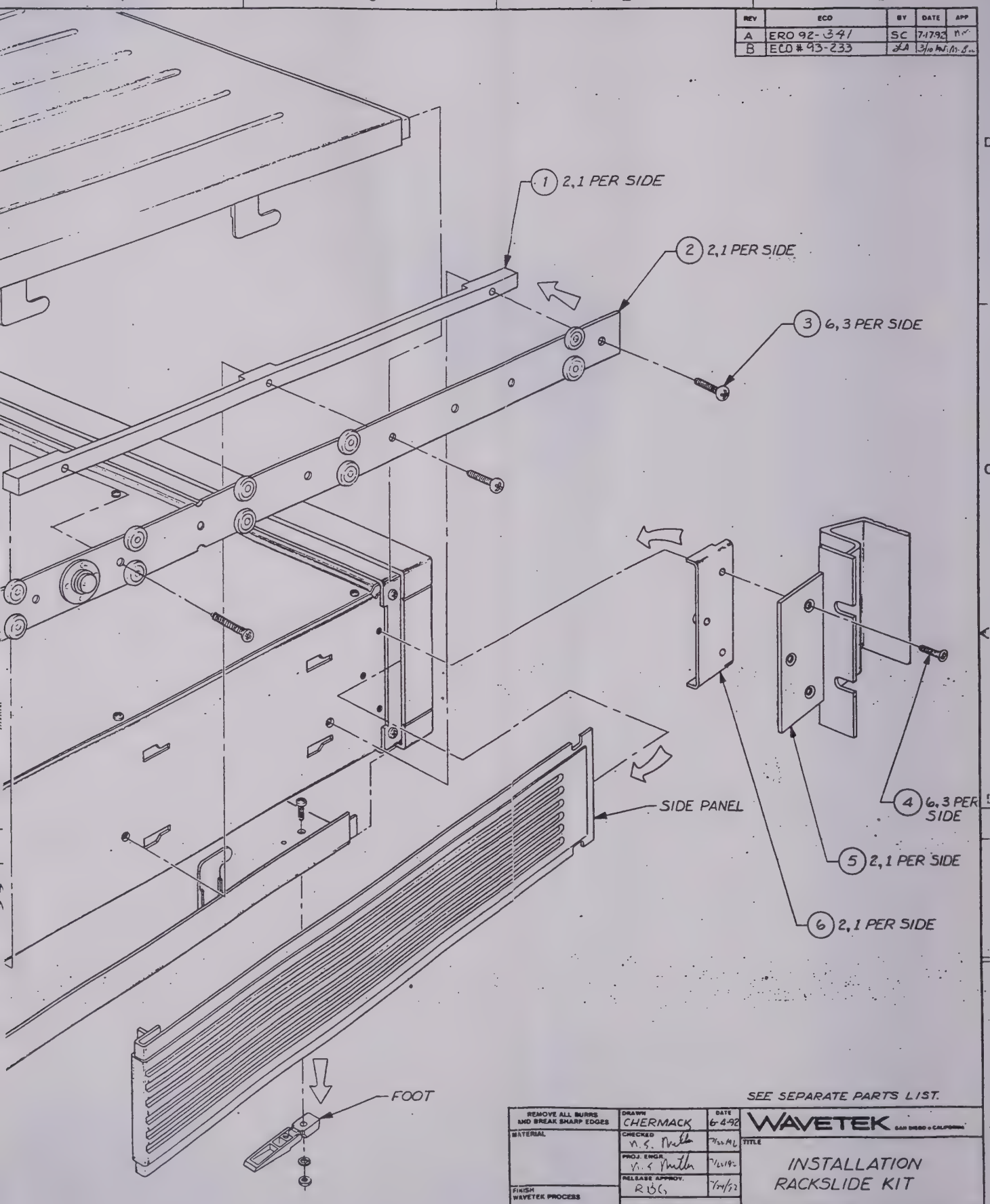
RACKSLIDE KIT INSTALLATION INSTRUCTIONS

STEPS

1. REMOVE COVER SCREWS, 2 PLACES PER COVER. SLIDE COVERS BACK AND OFF OF UNIT.
2. REMOVE SIDE PANEL SCREWS, 2 PLACES PER SIDE PANEL. SLIDE SIDE PANELS BACK AND OFF OF UNIT.
3. REMOVE FOOT MOUNTING HARDWARE AND FEET, 4 PLACES.
4. REINSTALL COVERS USING ORIGINAL SCREWS. SIDE PANELS DO NOT GET REINSTALLED.
5. INSTALL RACKEAR/HANDLE (ITEN NO.5) AND ADAPTER (ITEM NO.6) 2 PLACES, USING HARDWARE ITEM NO.4, 3 PLACES PER SIDE.
6. INSTALL RACKSLIDE (ITEM NO.2-ONLY INNER MEMBER IS SHOWN FOR CLARITY OF MOUNTING) AND ADAPTER (ITEM NO.1) 2 PLACES, USING HARDWARE ITEM NO.3, 3 PLACES PER SIDE. NOTE ORIENTATION OF ITEM NO.1. SURFACE WITH SLOTS MUST BE AGAINST SIDE OF CHASSIS.
7. ITEM NO'S. 7,8,9,10 AND 11 ARE NOT SHOWN ON DRAWING. THERE ARE EXTRA QUANTITIES OF SOME HARDWARE ITEMS INCLUDED.

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECO	BY	DATE	APP
A	ERO 92-341	SC	7-17-92	
B	ECO # 93-233	LA	3/10/93	



SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK 6-4-92	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED M.S. Mueller 7/13/92 ML	TITLE: INSTALLATION RACKSLIDE KIT
FINISH WAVETEK PROCESS	PROJ. ENGR. M.S. Mueller 7/13/92	
DO NOT SCALE DRAWING	RELEASE APPROV. RBG 7/14/92	SIZE D · FSCM NO. 23338 · DWG. NO. 1101-00-3659 · REV B
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS XX ± XXX ± ANGLES ±		SCALE NONE · MODEL 295 · SHEET 1 OF 1

A.1 INTRODUCTION

NOTE Any OK/CANCEL buttons that are normally part of the message that you see on the display have been omitted from the message descriptions given here.

Look for the message of interest under the following categories:

- Waveform Editing Messages
- Waveform Messages
- Sequences Messages
- Save/Restore Setup File Messages
- File Operations Messages
- Back-up RAM Messages
- Channel Grouping Messages
- External Connection Messages
- Instrument Messages
- PCX Image Message
- 3V Battery Check Message
- Disk Drive Messages
- Remote Operation Messages
- Self-Test and Calibration Messages
- Internal System Error Messages

A.2 WAVEFORM EDITING MESSAGES

Make connections to scope:
- Channel MAIN OUT and SYNC MARKER
- Chassis Z AXIS OUT to scope Z axis
Set up scope to .5V/division and 'X' sec/division
Trigger scope on SYNC OUT

This message appears as part of loading a waveform to be edited. It gives the proper scope setup in order to see the waveform in proper perspective. Failure to set the scope as indicated, especially the 'X' sec/division, results in a waveform exceedingly difficult to edit.

The message box has both BEGIN and CANCEL edit selections. Should you choose to CANCEL, the current output function is not changed.

Waveform memory
There appears to be a problem with waveform memory on the current channel card.

Waveform hardware
There appears to be a problem with the channel card hardware.

Bad waveform size
or
Insufficient waveform memory
Delete waveforms and try again
Both of these errors have the same cause. The current channel does not have enough free memory for the waveform you are attempting to load into it. You can delete individual waveforms by using the Delete menu of the Waveforms Management screen.

Block too large to copy
The block of the waveform that you have selected to copy is too big to copy. Model 295 must make a temporary version of the block, and there is not enough free memory currently in the instrument to contain the selected block. Either free more memory or select a smaller block.

Nothing to paste
Paste command chosen with no data in the paste buffer (no previous cut or copy).

Too many points in paste buffer
You are attempting to paste data into the waveform too close to the end of the waveform. Either move the insert point closer to the beginning of the waveform, or resize the waveform.

Original waveform cannot be restored after editing
You performed waveform edit on a waveform that is present only on the channel card (not saved). Model 295 does not keep a back-up copy of such waveforms so you cannot recover the original waveform. If the waveform exists as a file in backup RAM or on disk, this problem does not occur (and the message does not appear).

Waveform storage format is invalid
File chosen to load as a waveform is in a format not understood by Model 295. This is probably caused by naming a non-Waveform storage disk file with a name and extension that the model 295 believes to be a waveform file when it is not.

A.3 WAVEFORM MESSAGES

Waveform <name> already exists in channel memory
OK to Overwrite?

You have chosen to load a waveform with a name that is already present in the current channel's memory. This message gives you a chance to cancel the load so that you can copy the existing waveform to a permanent location, should you so desire. Otherwise, the existing waveform will be overwritten.

Load Waveform
Waveform <name> not found on <Source>

During restoration of a stored setup, the instrument could not find the named waveform where it was expected. <Source> is the source where the waveform was expected: disk drive or back-up RAM. The file may have been deleted or renamed. Since a required waveform could not be found, the channel is set to the default, standard function, SINE.

No Waveform or Sequence Active on channel <n>

From the Waveforms Management main screen, you have selected the Active menu choice, which is not available because the current channel is not running a user-defined waveform or a sequence.

Delete all Waveforms
Delete all waveforms in channel <n> memory?

From the Channel Waveform Memory screen, you have picked the DELETE ALL button. This message gives you the chance to cancel deleting all waveforms from the memory of channel <n>. Once deleted, they must be recreated or reloaded from nonvolatile memory (RAM or DISK).

A.4 SEQUENCES MESSAGES

The channel does not have enough memory to load the sequence.
Delete waveforms and try again.

While attempting to load a sequence, Model 295 has determined that the channel card does not have enough free waveform memory to load all the waveforms required for the sequence.

Rather than arbitrarily deleting waveforms to make room, the instrument cancels the sequence load and lets you decide which waveforms to delete to free up enough room. Use the "Delete" menu choice on the Waveforms screen to select individual waveforms to be deleted.

Overwrite Sequence <name>
Are you sure?

After editing, you have selected to save a sequence to a place in which a sequence of the same name already exists. This message gives you a chance to cancel the save so that the other sequence will not be lost.

Sequence Load
The requested sequence contains the waveform <name> which was not found on <Source>
While loading the sequence , Model 295 failed to find waveform <name> where it was expected. <Source> is either Back-up RAM or Disk. The channel is set to the default SINE function.

Load Sequence
Sequence <name> not found on <Source>
While restoring a saved set-up, Model 295 could not find the sequence file <name> called for by the saved set-up. <Source> is the expected location: disk drive or back-up RAM. The channel is set to SINE function since the sequence is unavailable. Restoration of the stored set-up is terminated.

Wait for Start Trigger
Signal or Start Sequence Now?
Whenever a sequence is loaded for execution on a channel, this choice is presented to let you decide how to start the sequence. If you choose START NOW, playback of the first waveform sequence begins immediately playback. If you choose WAIT, the first value of the first waveform in the sequence is output, and further playback waits for a trigger signal. That signal is whatever trigger is currently set for the channel's start trigger. Default is the channel's internal trigger rate generator, 1 kHz frequency.

No Sequence Active on channel <n>
From the Sequences Management main screen, you selected the "Active" menu choice when a sequence was not actually running on the current channel.

Sequence Save
Waveform <name> not found
During the save of a Sequence to Back-up RAM or to Disk, you selected the waveform segment <name> could not be found. The Save is not completed. This error is most likely to occur when doing a Sequence Copy with the "also copy waveforms" box selected. To clear up the problem, manually locate the waveform file and copy it to either the Sequence Source location.

A.5 SAVE/RESTORE SET-UP FILE MESSAGES

Invalid Saved Set-up file
Attempted to restore a file that was not a stored set-up.

Saved Set-up file: unsupported version
The chosen set-up file is in a format incompatible with the installed Model 295 firmware.

Error restoring saved set-up

An error occurred reading the contents of a saved set-up file. The restoration is aborted, but channel settings may be partially altered.

Set-up Save: Waveform or Sequence running on channel <n> exists only in channel memory (not saved). Set-up will not be restorable once instrument is turned off. Refer to Help: Instrument Stored Settings.

Model 295 is preparing to perform a SET-UP:SAVE. It detects that on one or more channels the current function is a user-defined waveform that exists only in channel card memory.

When power is removed, all waveforms in channel card memory are lost. If you attempt to recall this saved set-up after power is cycled, it will fail because the waveform will be gone. Until you cycle power, recall will work.

Ways to resolve the problem:

1. Cancel the Set-up Save. Edit the waveform on the channel, save it to disk or RAM, load it back up from there, then do the Set-up Save.

2. Confirm the Set-up Save. Before attempting to load the set-up after power is cycled, create a waveform with the same name as the one that was lost.

Set-up Save: Waveform or Sequence running on channel <n> was loaded from a different source than where the set-up is being saved to. Either copy the function to the same destination after Set-up Save is done, or cancel the save.

You are saving a set-up to disk or back-up RAM, but on channel <n>, the waveform running was loaded from another source. When a set-up is restored, it assumes that all waveforms or sequences are to be loaded from the source on which the set-up file itself resides. You must ensure that this is possible.

Either cancel the save, or after it completes make sure to copy running sequences or waveforms to the same location as the set-up file.

Waveform <name>, on Channel <n> has "X" markers in it, more than the 15 that set-up save allows. Set-up will not be restorable as is. Refer to Help: Instrument Stored Settings.

During the processing of a Set-up Save, model 295 detects that waveform <name> running on channel <n> has been edited with the Active Waveform Parameters screen to set more than 15 Markers ("X"). Only the first 15 markers can be saved.

If you want all markers saved, first save the waveform with Waveform Copy from the channel card to RAM or disk; the save will be done in binary format, which will include all markers. Load this waveform back to the channel memory and then do the Set-up Save. You will still see this warning message, but at restore time the binary waveform will contain all of the markers that the Set-up Save couldn't store.

Set-up Recall not possible with no channels installed
Model 295 will not execute a "Stored Set-ups Recall" menu choice if no channels are installed in the instrument. The request is ignored.

Invalid Saved Set-up
The file chosen is not a valid set-up file. This is probably due to an incorrect assignment of the .SCT extension. Model 295 checks the format of a chosen set-up file, and will reject anything suspicious.

Set-up Save: No channels installed. Nothing to save
Model 295 will not perform a Stored Set-ups Save menu choice if no channels are installed in the instrument. The request is ignored; no file is created.

Set-up <name> already exists
OK to overwrite?
A set-up with the same name as the one you are about to store, <name>, already exists in the chosen destination. You now have a chance to cancel the store, which protects the already stored set-up, or choose OK, which erases the stored set-up and stores the new one.

Stored Set-up Copy:
Error reading Sequence <name> from <Source>. "File not Present"
You are performing a Stored Set-ups Copy menu choice and have checked the "also copy waveforms" box. Set-up Store couldn't find Sequence <name> on source to copy it.

Sequence <name> has been edited since it was loaded from <Source>. Update stored copy to match running version?
During Stored Set-ups Save, you have used the Active Sequence Parameters screen to change Sequence <name>, which was loaded from <Source>. Unless you update the stored version of the Sequence to match the version currently running on the channel, the Set-up you are storing will not restore the unit to match the current configuration. This prompt asks you if Model 295 should automatically perform an update of the Sequence file as it stores the set-up.

A.6 FILE OPERATION MESSAGES

DELETE FILE: <extension>,<name> on <Source>
OK to delete it?
From the Utility: Files screen, you picked a file type (extension), called <name>, residing on <source>, for deletion. This message gives you a final chance to cancel the delete.

Format Disk
All data on disk will be lost.
Are you sure?
From the Utility: Files screen you selected Disk Format. This messages gives you a final chance to cancel the format. If you proceed, all data on the currently installed floppy disk will be permanently lost.

Format Results
Disk type: X
Bytes avail: Y
Bytes bad: D
Once floppy disk formatting is complete, this message reports the results. X is either 720 kB or 1.44 MB. Y is the amount of space available for user files. Z is the amount of space that had to be mapped as unavailable because no reliable formatting could be applied to it.

COPY FILE: <extension>,<name> on <Source>
OK to delete it?
The selected file <name>, <extension> file type (waveform, sequence. . .) already exists on <Source> (disk or back-up RAM) although it is the target for a copy file. This message gives you a chance to cancel over-writing the target file.

Cannot copy file to same name and destination as the source.
From the Utility: Files screen, you chose a file to copy, and then entered the same name for the new file, and placed it in the same destination (back-up RAM or disk). Change the name or destination.

A.7 BACK-UP RAM MESSAGES

Not enough storage memory
The file you are attempting to create takes more memory than is left in back-up RAM. Request denied.

Bad name
The file name given is illegal.

Name already exists in storage
A file name exists in back-up RAM that has the same type and name as that just entered.

A.8 CHANNEL GROUPING MESSAGES

Current channel <n> is a slave.
Frequency change affects master channel Y.

This message results when you change the frequency field on the Channel Set-up screen, and the current channel has been set as a slave channel at some earlier time from the Instrument Set-up screen.

If you continue with this frequency change, not only is the current channel's frequency changed, but also that of the master and all other slave channels.

You are given this warning only the first time that you attempt to change the frequency on the selected channel.

Channel is part of a group.
Clock cannot be changed here.
Adjust channel grouping?

You selected Clock BNC from the Channel Set-up screen for a channel that has been put in a group, via the channel grouping menu choice on the Instrument screen.

If you answer yes to the prompt, the channel grouping screen is automatically brought up, allowing you to remove the channel from the group. Answering no cancels the Clock BNC request.

Channel grouping: Grouping not possible with less than 2 channels installed

You selected Channel grouping with only one channel installed in Model 295.

Slave channels require a Master channel.

You selected "DONE" on the channel grouping screen after setting one or more channels to be slaves without also selecting a master channel.

This is an unworkable configuration; the offending channels are set to Independent operation and you are notified.

Channel 1 must be part of the group

You selected a channel without including Channel 1, which must be include due to hardware constraints.

All channels are reset to Independent operation and you are notified.

Only master or slave channels can be phase locked.
Lock setting ignored.

You selected "DONE" on the channel grouping screen with the Phase Lock box checked on a channel that is set to Independent (not part of the group). Only grouped channels can be phase locked.

The request to set phase locking for the independent channel(s) was ignored, but legal group settings were retained.

A.9 EXTERNAL CONNECTION MESSAGES

Internal clock output selected:
Make sure no external clock is
connected to clock BNC or select CANCEL

You have chosen to make the Clock BNC an output. If you have an external signal applied to the BNC, this selection can damage the external source, Model 295, or both. This message gives you a final chance to cancel the selection.

Internal Reference Selected:
Reference will be output on REF IN/OUT connector.
Make sure no external reference is connected or select CANCEL

From the 10 MHz REFERENCE menu, you have chosen the Output radio button. If you select "DONE", the internal signal will be routed to the rear panel REF IN/OUT connector. If an external input signal is also present, damage to Model 295 or the external source could occur, so you are given the chance to cancel the selection.

No External 10 MHz reference!

The current setting of the 10 MHz Reference is as an input. A valid external signal was present, and Model 295 switched itself to use it as the reference. However, that signal has been lost. Model 295 automatically switches back to its internal reference and gives this warning.

If a menu is being displayed when the external reference is lost, the warning message does not immediately appear until the menu is gone.

A.10 INSTRUMENT MESSAGES

Reset Instrument:
All channels will be set to default configuration
Are you sure?

You have chosen Reset Full Instrument from the Instrument screen. All channels will be set to the configuration in effect upon power-on. This message gives you a chance to cancel the operation.

Reset channel <n>:
Channel will be set to default configuration.
Are you sure?

You have chosen "Reset Current Channel" from the Instrument screen. The current channel (only) will be set to the configuration in effect upon power-on (Waveforms in channel memory are not affected.) This message gives you a chance to cancel the operation.

Reset Battery-Backed RAM:
All waveforms, sequences and set-ups will be deleted from backup RAM, and all system settings will be reset to default values. Are you sure?

You have chosen "Reset Backup RAM" from the Instrument screen . The listed items will be permanently lost unless you cancel this operation.

Execution error...

You are attempting to set channel card hardware to an illegal configuration. Additional lines in the message describe the problem in more detail.

Settings conflict...

A channel setting that you are altering would, if completed, conflict with some other parameter already in effect on the channel. Additional lines in the message describe what the conflict is.

Data out of range
Channel Error

You have attempted to set channel card hardware to a value outside the limits supported by the card.

High Voltage Option not installed.

From the Instruments screen, you chose the Options: High Voltage menu item. The High Voltage Option is not currently installed in the instrument, so the high voltage option screen is not available.

A.11 PCX IMAGE MESSAGE

PCX Image View Image is too large

You have selected a PCX file from the floppy diskette that is larger than 320 horizontal or 200 vertical pixels in size. Model 295 cannot display such images.

A.12 3V BATTERY CHECK MESSAGE

3V Battery Check
FAIL
Level is below 2.7V

The voltage of the internal battery that preserves the contents of back-up RAM while the instrument is off. This back-up RAM is the "Battery-Backed RAM" that is a selection for file operations. It is also where user preferences such as LCD viewing angle are maintained. If the voltage is below 2.7 volts, RAM contents may not be retained when power is removed.

This warning message tells you it is time to replace the lithium battery inside the unit.

This battery has no connection with instrument calibration data.

A.13 DISK DRIVE MESSAGES

Disk directory full
Couldn't create file on disk — disk has no more room for file names.

File not found
Specified file not found on floppy disk.

File already exists
Specified file already exists on the floppy disk. This message can result from copies or saves to the disk where you enter a name rather than pick from a list.

File is read-only
You attempted to modify or delete a read-only file on floppy. Take the floppy disk to an MS-DOS machine, and remove the write protection from the file.

Improper disk file name
File name entered is not a legitimate DOS name.

Cannot read or write volume or directory name
During formatting, disk was unable to properly access track-0 on floppy.

Disk has bad track
Read or write has problem with a bad or improperly formatted track.

Insufficient memory to perform disk operation
Not enough system memory remaining to properly buffer data to or from the floppy disk.

Disk drive not installed
You selected a disk operation, but the disk drive option is not present.

Not enough room on disk
Attempted write operation needs more space than remains free on the current floppy disk.

Cannot write to existing file
Attempted to delete or write to a file that was write-protected.

Unexpected end of disk file
The file being read from the floppy is listed in the disk directory as having a particular size. However, when Model 295 actually read the file, it encountered the end of the file sooner than expected. Results of the operation are undefined. The disk is probably corrupted and should be reformatted (after copying any importantly files to another disk).

Disk controller failure
Hardware that supports the floppy disk drive is not functioning properly.

Disk read error
or
Disk read incomplete
or
Disk read data loss
Unrecoverable error when reading data from floppy disk. This could be a problem with a file, or with the catalog section of the disk.

Disk is write protected
A write operation to a floppy failed because the write protect hole in the floppy has been opened, making disk writes impossible.

Disk cannot be formatted: write protected
Attempt to format a write protected disk. Not possible.

Disk write error
or
Disk write data loss
Unrecoverable error writing data to floppy disk. Writing to any portion of the floppy may generate this error.

Format not completed
Diskette format aborted because of some problem that has already been reported.

Disk read status
There has been a controller failure during disk operations.

A.14 REMOTE OPERATION MESSAGES

Value cannot be changed while under remote control

You attempted to change a value from the front panel while Model 295 is under remote control. You may view most screens while in remote, but parameters cannot be altered. Go to the Utility: Remote Configure screen and select the "GO TO LOCAL" button to re-enable working with the instrument via the front panel.

Cannot change remote source while in remote

From the Utility: Remote Configure screen, you attempted to change the remote source field while the instrument was under remote control. You must select "GO TO LOCAL" first.

A.15 SELF-TEST AND CALIBRATION MESSAGES

Must successfully perform auto calibration before manual calibration

The Test / Cal manual calibration portion of the Instrument screen cannot be entered if self-calibration has never been performed or has failed.

Calibration data appears to be invalid.
Store defaults?

Channel card repair has caused on-board calibration data to become invalid. Saying Yes to this prompt allows Model 295 to install on the channel card some fairly accurate default values. Self-calibration and manual calibration should then be performed.

Cal settings have changed.
Proceed without saving?

Manual calibration values for the current channel have been changed, but the results not yet permanently stored with the Store Calibration button. If you exit from the manual calibration screen, or change the channel, without first saving altered calibration values, the changes will be lost.

This message gives you a chance to remain on the current channel / manual calibration screen and store the changes.

Calibration Result chan X
Hex: Y
Decimal: Z

After a self-calibration is completed for Channel X, results are reported by this message. A value of 0 indicates proper self-calibration. Any nonzero value can be used by technicians to diagnose channel card hardware failures. The results are reported in both hexadecimal (Y) and decimal (Z) formats.

Self-Test Result chan X
Hex: Y
Decimal: Z

After a self-test is completed for Channel X, this message reports the results. A value of 0 indicates proper self-test. Any other value can be used by technicians to diagnose channel card hardware failures. The results are reported in both hexadecimal (Y) and decimal (Z) formats.

A.16 INTERNAL SYSTEM ERROR MESSAGES

If any of these are seen, contact Wavetek customer service. It would be of help if you can provide a sequence of steps that can duplicate the error message.

Insufficient system memory available
Failure in internal communications
Waveform initialize problem
Waveseq utility
Waveform not found
Sequence not found
Waveform system memory problem
Waveform already exists
Seq util
Set func
Def trace
Trace add
Help access failure
Invalid help data
Invalid help selection
Feature not yet implemented
Edit set-up/recall
Too many disk files opened
Name not found in Battery-Backed RAM
Unknown Backup RAM file type

Appendix B contains six menu quick reference guides. One for each of the Model 295 main menus:

- Channel Setup Screen guide
- Trigger Setup Screen guide
- Waveforms Screen guide
- Sequence Screen guide
- Instrument Screen guide
- Utilities Screen guide

For more details on items in these guides, refer to Section 4 of the Model 295 Operator's Manual.

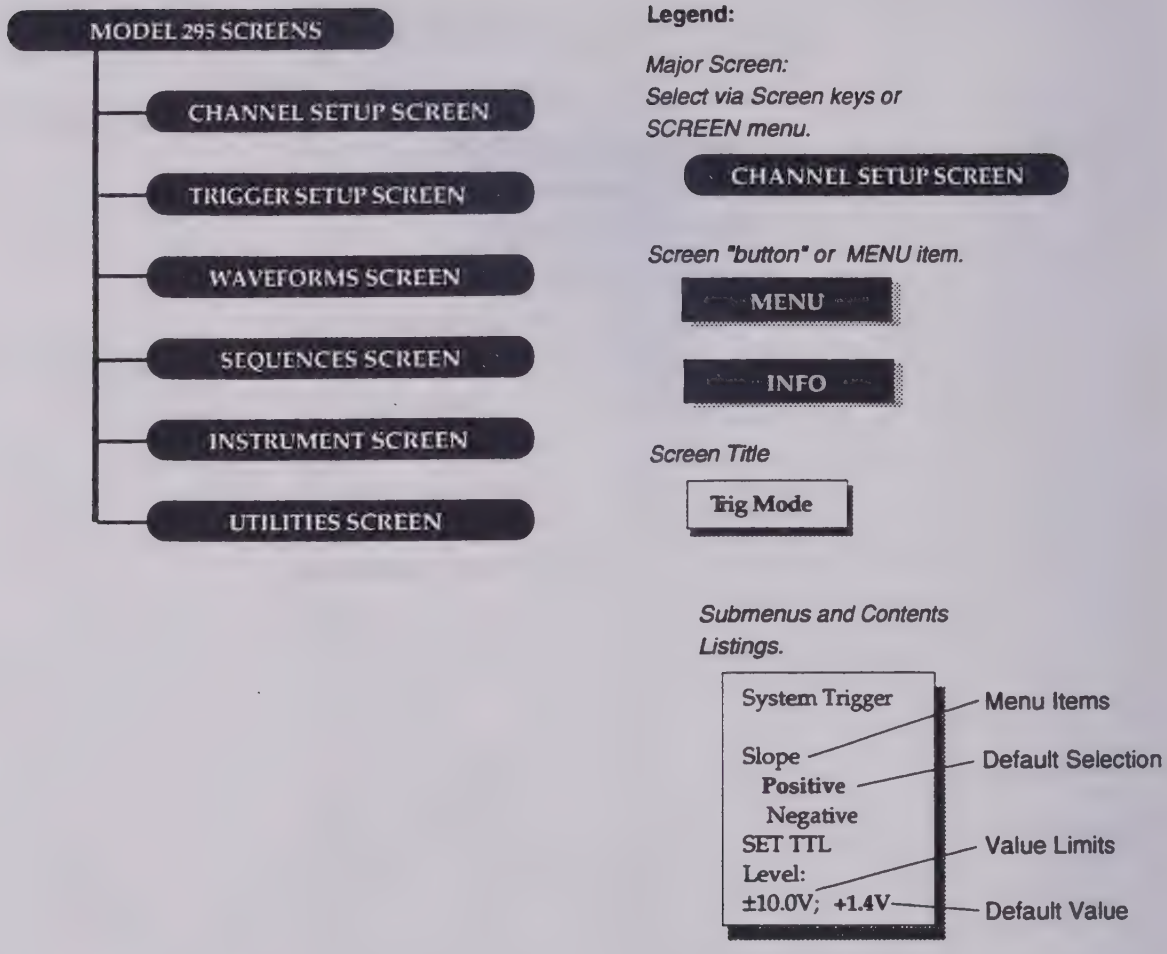


Figure B-1. Menus Quick Reference Legend

Figure B-2. Channel and Trigger Setup Screens

Figure B-3. Waveforms Setup Screen

Figure B-4. Sequence Setup Screen

Figure B-5. Instrument and Utilities Setup Screens

C.1 INTRODUCTION

Appendix C contains additional information for the Standard Commands for Programmable Instrumentation (SCPI) that is not covered in detail in Section 5 (Remote Operation) of the model 295 Operator's Manual. First is a SCPI Primer intended to provide the first-time SCPI user/programmer with a quick overview of the information contained in SCPI 1992 Specification. Following the primer is a number of figures representing the SCPI Command set of the model 295 given in a Command Tree rather than the common Command Table format. Finally, this appendix includes the SCPI Conformance Information required by the specification.

C.2 SCPI PRIMER

SCPI traces its lineage to IEEE 488.1 and IEEE 488.2. Although the IEEE 488.2 standard addresses some instrument measurements, it principally deals with common commands and syntax or data formats. With SCPI, a variety of modular instruments have a universal language, even though they have different functions and manufacturers. Please refer to the IEEE 488.2 and SCPI reference manuals for more information.

IEEE 488.1 relates to the physical connection between the instrument and its remote control unit, how the data is transmitted between the two, and the method used to determine master and slave.

IEEE 488.2 encompasses and builds upon IEEE 488.1 by adding syntax and data requirements for the communication path. In addition, it also defines the commands that are to be common to any and all units, and the query format for data retrieval from the remote instrument.

SCPI adds the fine detail of instrument setup by establishing a hierarchy of standard command formats and subsystem routing, reducing the number of ways to control similar functions.

An example of vertical consistency (same instrument type) would be multimeters from different manufacturers implementing the command to measure a value of DC voltage in the same manner using the *Measure subsystem*. An example of horizontal consistency (different instrument types) would be different instruments using the same command to trigger a function using the *Trigger subsystem*. Refer to Figure C-1.

Queries of the instrument by the controller result in well-defined status response and measurement data.

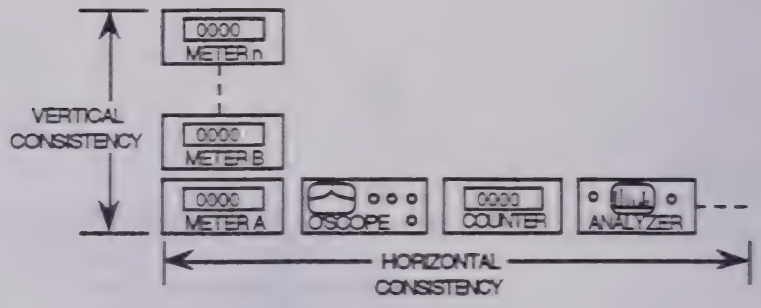


Figure C-1. Command Consistency

The user need not be concerned about the interface commands, the common commands, or the syntax and data structures; they are IEEE 488.1 and IEEE 488.2 definitions and have not changed within SCPI. Not all instruments use all commands, but all instruments use the same command format. Using the language rules and the hierarchical nature of the command structure, new commands, parameters, and subsystems can be developed from the existing primitive elements and commands as new instruments are introduced.

The hierarchy of subsystem commands in SCPI is called a *Command Tree* (sometimes also called a *Command Flow Chart*). The SCPI Command Tree is upside-down, i.e., the Root is at the top with branches extending downward, ending with the parameter required for the branch function (refer to figure C-2.)

There is only one route to travel to reach the destination keyword or parameter on the selected branch. More than one command may have the same keyword, but on different branches. These commands usually perform a similar function in the respective branches; however, each can only be reached by a unique path.

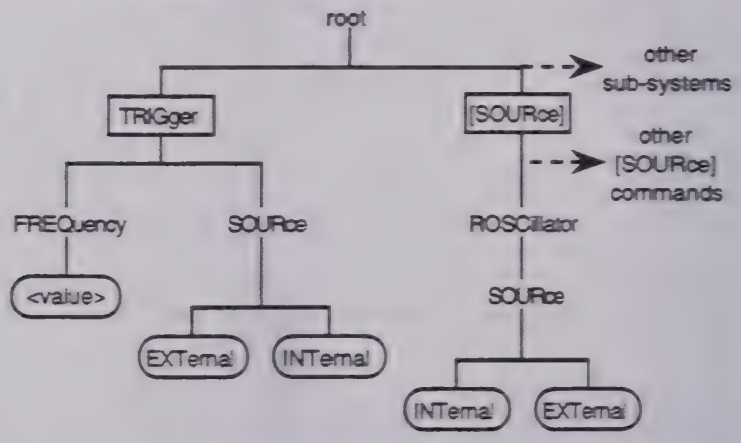


Figure C-2. Same Keywords in Different Subsystems

The command hierarchy can also be represented by a *Command Table* and by *Syntax Diagrams*. Example are given in the following paragraphs.

Parameters

The parameter specifies the finest detail that is required in a branch. Most parameters have a defined default value at power-up or *RST. Parameter defaults are specified in the manual for each instrument. There are three major types of parameters: *Character* (Discrete), *Decimal Numeric*, and *Boolean*.

Character parameters are a one word character label, usually *one of a number of choices*, that defines a characteristic (e.g. ZCROs - the abbreviation for Zero Crossings). Failure to include a numerical suffix with a Character parameter requiring one, will result in the assuming of a command with the lowest value suffix (e.g., the command TTLTrg without any suffix will default to TTLTrg0).

Decimal Numeric has an extended set that may be implemented. Decimal Numeric may not be used as a subset (e.g., 1 of n lines), but may be used as a value definition (e.g., start value = 10). Subsets are implemented by using a suffix with a Character (e.g. Line2). Decimal Numeric also covers the "label" type of parameter, the signal name (e.g., SIN1). The extended numeric set covers the special numbers MAXimum and MINimum which are required and DEFault, which is optional.

Boolean parameters can have one of two values, usually ON or OFF. Boolean values can also be represented by 1 or 0 on the command line. Queries requesting a Boolean value will always return either 1 or a 0.

SCPI convention shows parameters in text and on the Command Tree with angle brackets (<>) if they are values or names to be entered by the user. Parameters with a character (discrete) keyword or Boolean parameters do not use the angle brackets. Wavetek convention shows parameters in the command tree enclosed within an oval "box". The default parameters that are selected at power-up or *RST are shown in shaded oval boxes.

Queries

Any command that sets a value can be queried about the current value of the setting. The query form of the command ends with a question mark (?). Some commands are defined as queries only and can be identified by the question mark used after them in the command tree. Some commands are events only and do not have a query form. These can usually be identified by their action nature such as DELete or IMMediate. The values of the special numbers of MAXimum, MINimum, and DEFault may also be queried.

SCPI Punctuation and Syntax

Keywords can be abbreviated or used in full. SCPI requires the exact abbreviation or the exact full spelling only; capital and lowercase letters have equal weight. The long form of the keyword may be either a single word or a phrase that has been abbreviated to a single word. The SCPI convention is to use the entire keyword in any text or instructions with the accepted abbreviation shown in capital letters.

In addition, Wavetek makes the capital portion **bold** to show the minimum command requirements at a glance, and sets it off by using a different typeface. For example,

FREQuency

Common commands must start with an asterisk (*). SCPI commands optionally start with an colon (:). Each time a colon is inserted in the command line, the pointer is instructed to move down the branch that has the keyword immediately following. A semicolon separates a string of commands on one line. If a colon does not follow the semicolon, the pointer remains at the same level. A colon following the semicolon will set the pointer back to the root. The commands do not become effective until a Program Message Terminator is received at the end of the command line. An incorrect command line will generate an error message.

Condensed Rules:

- Power-on and Reset

  After power is applied, the command pointer is set to the root, and all parameters, to default values (*RST does not set the Trace memory to default values).

- Command line termination

  When the command line is terminated with a Program Message Terminator, the pointer is set to the root level.

- Colon

  The optional leading colon in a command line indicates the keyword immediately following is at the root level (a subsystem).

  A colon between command keywords indicates the pointer is to step down one level to the immediately following keyword.

- Semicolon

  The semicolon separates commands within the same message without changing levels.

- White space (space bar or tab)

  White space must be used to separate commands from parameters. White space must not be used within a command keyword. Otherwise, SCPI usually ignores the white space.

- Comma

  When a command requires a series of parameters, they must be separated by commas.

- Question Mark

  The question mark is placed after the program header creating a query. A parameter may be placed after the question mark where appropriate (for example, ...LIMits? <trace name>). Some event commands do not have a query form (for example, DELete). Some commands are queries only (for example, FREE?).

- Common Commands

  Common commands (*RST, *TRG, etc.) are acted on the same way regardless of which subsystem or into which level of the SCPI test program they are written. After execution of the common command, the SCPI command pointer returns to the point where it was interrupted (the exception is *CLS: the pointer is set back to the root). The *RST command resets all subsystems to default values except Trace memory; it does not set the pointer back to the root.

Text Symbols

- Square brackets

  Commands or portions of parameters that are optional are enclosed by square brackets ([ ]).

- Angle brackets

  Angle brackets (< >)enclose parameters that are to be entered by the user, usually either numeric labels (names) or numeric data (levels, values).

- Vertical line

  The vertical line (|) represents an exclusive OR; one of the values shown must be used.

TRACE NAMES (numeric label data)

The following restrictions govern parameter names (user waveform names):

1. They cannot exceed 12 characters in length, preferred length is 4.
2. They must not have any embedded white space.
3. They *must* start with an alphabetic character. They cannot start with a numeric, a white space, or an underscore.
4. All alphanumeric characters may be used, both capital and lower case. The underscore (_) may also be used.
5. There is no abbreviation for the user's trace name; it must be used as defined.

The command hierarchy can be represented in three ways: the **COMMAND TREE**, the **COMMAND TABLE**, or the **COMMAND SYNTAX DIAGRAM**. All three are illustrated on the following pages (also refer to figure C-3).

Example Command Tree

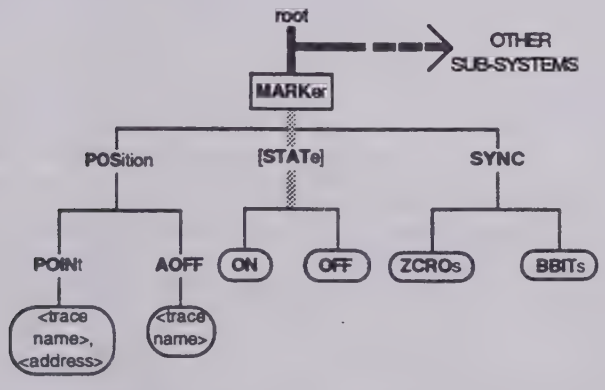


Figure C-3. Example (Marker Subsystem) Command Tree

Example command lines for this subsystem follow. Assume that a trace name and size have been entered and a trace name is currently selected. Only the entered trace name is acted upon by the commands except in the case of global commands such as DELete:ALL, MODE, etc. The long form of the keywords is given with the approved (or Wavetek selected) abbreviations in capitals. Items in **bold**, with the exception of optional commands, are minimum requirements.

The first character on the command line is the colon (:). This places the pointer at the root and just above all subsystems. The leading colon is optional if the command pointer is already at the root. The following example shows the development of the command line by traversing down the tree. Select the MARKer subsystem by entering

```
:MARKer
```

There are three branches in the Marker subsystem; select SYNC by entering it after MARKer:

```
:MARKer:SYNC
```

Sync has two discrete type parameters. Select one, ZCROs. Enter a <space>, then ZCROs, then a <program message terminator> (<PMT>).

NOTE *The <PMT> is not shown in the example command lines, but it is necessary to enter a command string into the controller.*

```
:MARKer:SYNC ZCROs
```

If, after setting markers at various locations in the waveform, the markers are in unacceptable locations, turn them all off using the AOFF subcommand (AOFF has no abbreviations).

```
:MARKer:POSition:AOFF <trace name>
```

Now, set the marker(s) to the position(s) desired. This command sets only one marker position (high) at a time; if more than one is desired, repeat the command for each position. There must *not* be any white space between the comma and either parameter. The <address> is a numeric value.

```
:MARKer:POSition:POINt <trace name>,<address>
```

The desired marker selections have been completed. Now, turn the marker ON. This command can use one of several formats, the complete command follows:

```
:MARKer:STATe ON
```

Because the STATe command is optional (the square brackets, [ ], in the command tree show this), it need not be entered on the command line:

```
:MARKer ON
```

Because the ON parameter is Boolean, it can be replaced by 1, if desired:

```
:MARKer:STATe 1
```

Both of the options have been exercised in the following command line. The syntax selected for the command depends upon the user.

```
:MARKer 1
```

Not including the query, the commands could have been entered in a string of four commands on one program line, using the semicolon and colon, as follows:

```
:MARKer:SYNC ZCROs;POSition:AOFF <trace name>;POINt
   <trace name>,<address>;:Marker 1
```

Enter a request for the marker state (this does not change the state).

```
:MARKer:STATe?    or    :MARKer?
```

Because the marker has been turned ON, the Boolean response will be:

```
1
```

Example Command Table

The command tree can also be presented as a table. The hypothetical instrument command tree portion of Figure C-3 is shown below as Table C-1. The symbols used with the tree are also used with the table.

The angle brackets (< >) indicate the parameter is entered by the user. Lowercase text between the angle brackets shows the parameter that is expected. ON/OFF are Boolean parameters. Discrete parameters often appear as command keywords in the command table, but must not be confused; a white space is still required before them on the command line.

All parameters have manufacturer-specified default values that will exist at power-up or *RST. Numerical values that are out of range for the branch will not be acted upon and will return an error when the SYSTem:ERRor? query is sent.

The square brackets ([ ]) are optional commands that are not required in the command line, but may be used for documentation clarity. Some parameters or portions of parameters that are optional are shown with square brackets around them.

Table C-1. EXAMPLE MARKER COMMAND TABLE

COMMAND	PARAMETERS	PARAMETER TYPE
:MARKer		
POSition		
POINt	*<name>*	numeric (label)
	<address>	numeric
AOFF	*<name>*	numeric (label)
[STATe]	*state (optional)*	Boolean
SYNC	*sync detector type*	discrete

Under the "Command" heading in the table, the subsystem command is not indented. Each subcommand is indented showing the level of subordination. The Parameter column indicates the parameter expected for the command. The Parameter Type column shows the type of parameter for the subcommand

Example Command Syntax Diagrams

The command list can also be presented as a syntax (or *railroad*) diagram. The hypothetical instrument command tree in Figure C-3 is shown on the following pages as syntax diagrams. Some symbols used with the tree are also used with the diagram.

Syntax diagrams (sometimes called railroad diagrams because they look like railroad layouts) are another way to present the command flow. There is a syntax diagram for each command in a subsystem. As with the command tree and the command table, syntax diagrams have some unique symbols.

The rectangular box contains command and subsystem keywords with their abbreviation in capital letters.

Ovals contain parameters; Ovals are defaults. The angle brackets (< >) contain user-entered parameters.

The circle encloses punctuation ("sp" implies white space).

The arrow shows the command direction flow. The flow is usually from left to right, but the command may contain loops flowing in other directions.

Figure C-4 shows how the sync is selected, the form of the query form, and the parameters available using the syntax diagram format. The bypass around the leading colon indicates it is optional in the command line. The default parameter is shown by the shading. At each place the line splits, a decision must be made as to which path will be followed. The command is completed when the exit arrow is reached.

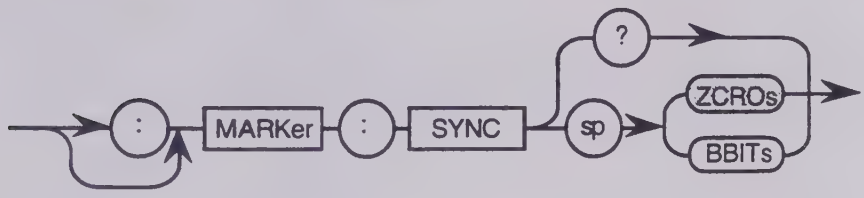


Figure C-4. Sync selection

Figure C-5 shows the All Off command. There is no query form of the command; AOFF is an event.

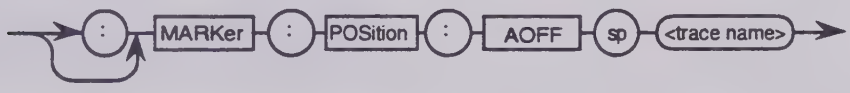


Figure C-5. All markers OFF command

Figure C-6 shows the command for setting the point address.

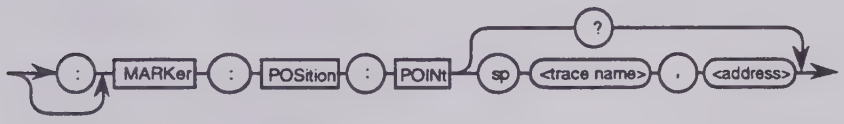


Figure C-6. Set the marker point address

Figure C-7 shows the bypass around the optional STATe command. The entire Boolean parameter complement is in the diagram with both OFF and 0 shown as default. The OFF parameter is equal to 0, and ON is equal to 1; equal parameters are interchangeable in the command line.

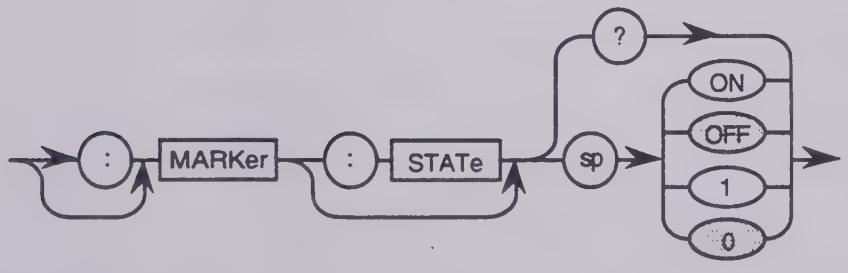


Figure C-7. Set the marker state.

The query to show the output state will return only the Boolean values of 1 or 0.

Low Level Interface Commands

The Arb responds to the following low level VXIbus interface commands. These are issued by its commander. Refer to the VXIbus specification for further information.

ANOP Abort Normal Operation
The arb ceases its normal operation as fast as possible. The *ready* bit in the Status register is reset to 0. The unit is reconfigured to the default state; the power-up memory test is NOT performed. The command has the same effect as ***RST** and ***CLS**.

BNOP Begin Normal Operation:
The *ready* bit in the Status register is set to 1, and the device is ready to receive data.

CLE Clear
The arb removes all output data in the VXI Data Low register and makes ready to receive a new command. The input and output queues are cleared. The *read ready* bit in the Response register is reset to 0. The *Err** bit of the Response register is de-asserted, and any pending *read protocol error* command responses canceled.

ENOP End Normal Operation
The arb ends its normal operation in an orderly manner without any time limit constraints. Incoming signals are no longer processed. The *ready* bit of the status register is reset to 0. The current arb configuration is maintained.

ICOM Identify Commander
The VXI bus Commander uses this command to tell the arb its logical address.

RPE Read Protocol Error
The VXIbus commander uses this command to query the cause of the last protocol error.

RPR Read Protocol
The VXIbus commander uses this command to find out what protocols in addition to the Word Serial protocol the arb supports. (The arb supports I, I4, EG, and RG.)

RSTB Read Status Byte
This command is used by the commander to read the status byte from the arb.

C.3 MODEL 295 SCPI COMMAND TREES

Figures C-8 through C-15 provide a complete set of SCPI Command trees for Model 295. These trees are an alternate method (to the Command Table) of constructing syntactically correct SCPI commands.

C.4 MODEL 295 SCPI COMMAND TABLE

Table C-2, model 295 SCPI Command Syntax, provides a complete set of SCPI Commands for the Model 295. The Command Table is the primary means of constructing syntactically correct SCPI commands.

Figure C-8. Subsystems (Root Node)

Figure C-9. INITiate, MMEMory, CALibrate, TEST, and RESET Subsystems

Figure C-10. SOURce Subsystem

Figure C-11. TRACe Subsystem

Figure C-12. TRIGger Subsystem

Figure C-13. OUTPut Subsystem

Figure C-14. SYSTem Subsystem

Figure C-15. DISPlay and HVOLtage Subsystems

SCPI CONFORMANCE INFORMATION

This Appendix contains compliance data as required by the SCPI 1992 Specification, Volume 1: Syntax and Style, Paragraph 4.2.3, Documentation Requirements.

Model 295 SCPI Version

The Model 295 50 MHz Arbitrary Waveform Generator has been designed to comply with SCPI Version 1992.0, dated February 1992.

Model 295 SCPI Command Syntax

The SCPI specification, Ver 1992.0, defines three type of SCPI commands that may be used in a SCPI product: Confirmed Commands, Approved Commands, and commands that are not part of the SCPI definition.

SCPI Confirmed Commands

Confirmed Commands are those commands which are published in the SCPI 1992 Specification, Volume 2: Command Reference. Refer to Table C-2 for the complete syntax of Model 295 SCPI commands. Model 295 Confirmed Commands will be identified with the notation "Confirmed" in the third column.

SCPI Approved Commands

Approved Commands are those commands that have been approved by the SCPI Consortium, but are not published in the SCPI 1992 Specification. Refer to Table C-2 for the complete syntax of Model 295 SCPI commands. Model 295 Approved Commands will be identified with the notation "Approved" in the third column.

Commands not part of the SCPI Specification

The SCPI Specification does allow products using the SCPI language to include specialized commands that are outside of the SCPI definition. Refer to Table C-2 for the complete syntax of Model 295 SCPI commands. Any Model 295 commands which are not in the SCPI definition are identified with the notation "Not SCPI Approved" in the third column.

Incomplete Command Implementation

The SCPI definition specifies each command completely, and if the command keyword is at the *leaf node*, it specifies the parameter data and query responses. In some cases, a SCPI product may not implement all of the choices given in the specification.

For example, when parameter character data is in the form of a list of choices, the product's hardware may not support all of those choices:

[SOURce]:FREQuency:MODE <CW | FIXed | SWEep | LIST | SENSe>

In this example, a complete list of possible Frequency Modes is given. However, the product's feature set may want to have a settable Frequency Mode in order to set a CW | FIXED frequency, and to enter a Frequency Sweep Mode. The LIST and SENSe modes may not have any hardware to support them. In this case, the SCPI Syntax Table (see Table C-2) would use footnotes to indicate partial conformance to the SCPI Specification.

Table C-2. Model 295 SCPI Command Syntax

KEYWORD	PARAMETER FORM	NOTES
CALibration<n>		Confirmed
[:ALL]?		Confirmed
:DATA	<arbitrary block program data>	Confirmed
:AFCorrection	<point>,<frequency>,<gain>	Not SCPI Approved
:AMPLitude		Not SCPI Approved
[:GAIN]	<numeric_value>	Not SCPI Approved
:OFFSet	<numeric_value>	Not SCPI Approved
:AMZero	<numeric_value>	Not SCPI Approved
OFFSet		Not SCPI Approved
[:GAIN]	<**POSitive** | NEGative>,<numeric_value>	Not SCPI Approved
:OFFSet	<**POSitive** | NEGative>,<numeric_value>	Not SCPI Approved
:PAZero	<numeric_value>	Not SCPI Approved
:SCMZero	<numeric_value>	Not SCPI Approved
:STORe		Not SCPI Approved
:SQRSymmetry	<numeric_value>	Not SCPI Approved
:STATe	<boolean>	Confirmed
INITiate<n>		Confirmed
[:IMMediate]		Confirmed
:CONTinuous	<Boolean>	Confirmed
MMEMory		Confirmed
:CATalog?	<RAM | DISK>	Confirmed[1]
:COPY	<source_name>,<RAMIDISK>,<dest_name>,<RAMIDISK>	Not SCPI Approved
:DELete	<file_name>,<RAM | DISK>	Confirmed[1,2]
:INITialize	<RAMIDISK>	Not SCPI Approved
:LOAD		Not SCPI Approved
:SEQuence	<n>,<sequence_name>,<RAMIDISK>	Not SCPI Approved
:SETup	<setup_name>,<RAM | DISK>	Not SCPI Approved
:TRACe	<n>,<trace_name>,<RAMIDISK>	Not SCPI Approved
:STORe		Not SCPI Approved
:SETup	<setup_name>,<RAM | DISK>	Not SCPI Approved
:TRACe	<n>,<trace_name>,<dest_name>,<RAM | DISK>	Not SCPI Approved
OUTPut<n>		Confirmed
:CLOCk		Not SCPI Approved
:FREQuency	<numeric_value>	Not SCPI Approved
:MASTer		Not SCPI Approved
:SOURce	<**INTernal** | EXTernal>	Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
:SOURce	<**RASTer** | SYNThesizer>	Not SCPI Approved
:FILTer		Confirmed
[:LPASs]		Confirmed
[:STATe]	<Boolean>	Confirmed
:SELect	<**ELLiptic**| BESSel>	Not SCPI Approved
[:STATe]	<Boolean>	Confirmed
:SUMBus		Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved

Table C-2. Model 295 SCPI Command Syntax (Continued)

KEYWORD	PARAMETER FORM	NOTES
:TRIGger		Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
:SOURce	**<BIT** | BCOMplete | LCOMplete>	Not SCPI Approved
RESet<n>		Confirmed
[SOURce<n>]		Confirmed
:AM		Confirmed
[:STATe]	<Boolean>	Confirmed
:MODE	**<AM** | SCM>	Not SCPI Approved
:CLOCk		Not SCPI Approved
:CONFigure	**<INPut** | OUTPut>	Not SCPI Approved
:FREQuency		Confirmed
[:CW | FIXed]	<numeric_value>	Confirmed
:MANual	<numeric_value>	Confirmed
:MODE	**<CW** | **FIXed** | SWEep>	Confirmed[2]
:RASTer	<numeric_value>	Not SCPI Approved
:STARt	<numeric_value>	Confirmed
:STOP	<numeric_value>	Confirmed
:FUNCtion		Confirmed
[:SHAPe]	<shape_name>	Confirmed
:USER	<trace_name>	Not SCPI Approved
:MODE	**<FIXed** | SEQuence>	Confirmed[1]
:GROup	<numeric_value>	Not SCPI Approved
:MARKer		Confirmed
:POSition		Not SCPI Approved
:AOFF	<trace_name>	Not SCPI Approved
:POINt	<trace_name>,<point_index>	Not SCPI Approved
:ZAXis		Not SCPI Approved
:AOFF	<trace_name>	Not SCPI Approved
:POINt	<trace_name>,<point_index>	Not SCPI Approved
:SYNC		Not SCPI Approved
:SOURce	**<ZCRoss** | BBITs>	Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
:TRIGger		Not SCPI Approved
[:STATe]	<trace_name>,<Boolean>	Not SCPI Approved
:PHASe		Confirmed
[:ADJust]	<numeric_value>	Confirmed
:MODE	**<INDependent** | MASTer | SLAVe>	Not SCPI Approved
:ROSCillator		Confirmed
:SOURce	**<INTernal** | EXTernal | BUS>	Confirmed[1]
:SEQuence		Not SCPI Approved
:ADVance	**<AUTOmatic** | TRIGgered>,<list_index>	Not SCPI Approved
:DWELl	<numeric_value>,<list_index>	Not SCPI Approved
:FUNCtion	<trace_name>,<list_index>	Not SCPI Approved
:LENGth	<numeric_value>	Not SCPI Approved
:TRIGger		Not SCPI Approved
:SENSe	**<EDGE** | LEVel>	Not SCPI Approved

Table C-2. Model 295 SCPI Command Syntax (Continued)

KEYWORD	PARAMETER FORM	NOTES
[SOURce] (cont'd)		
:MODE	<**SYNChronous** | ASYNchronous>	Not SCPI Approved
:SUMBus		Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
:ATTenuation	<numeric_value>	Not SCPI Approved
:SWEep		Confirmed
:COUNt	<numeric_value>	Confirmed
:DIRection	<**UP** | DOWN>	Confirmed
:MODE	<**CRESet** | TRESet | HRESet | CREVerse | TREVerse | HREVerse | MANual>	Confirmed[1]
:SPACing	<**LINear** | LOGarithmic>	Confirmed
:TIME	<numeric_value>	Confirmed
:VOLTage		Confirmed
[:LEVel]		Confirmed
[:IMMediate]		Confirmed
[:AMPLitude]	<numeric_value>	Confirmed
:OFFSet	<numeric_value>	Confirmed
SYSTem		Confirmed
:CHECksum?		Not SCPI Approved
:ERRor?		Confirmed
:DATE	<year>,<month>,<day>	Confirmed
:KEY	<numeric value>	Not SCPI Approved
:TEST?		Not SCPI Approved
:REFerence		Not SCPI Approved
:SOURce	<**INTernal** | EXTernal>	Not SCPI Approved
:TIME	<hour>,<minute>,<second>	Confirmed
:TRIGger		Not SCPI Approved
[:IMMediate]		Not SCPI Approved
:LEVel	<numeric_value>	Not SCPI Approved
:POLarity	<**POSitive** | NEGative>	Not SCPI Approved
:TTL		Not SCPI Approved
:VERSion?		Confirmed
:ZAXis		Not SCPI Approved
:LEVel	<numeric_value>	Not SCPI Approved
:POLarity	<**POSitive** | NEGative>	Not SCPI Approved
TEST<n>		Confirmed
[:ALL]?		Confirmed[1]
:RAM?		Confirmed[1]
TRACe<n>		Confirmed
:ADDRess?		Not SCPI Approved
:CATalog?		Confirmed
:DEFine	<trace_name>,(<trace_name> | <numeric_value>)	Confirmed
[:DATA]	<trace_name>,(<trace_name> | <block>)	Confirmed
:LINE	<trace_name>,<point_index1>,<point_value1>, <point_index2>,<point_value2>	Confirmed
:POINt	<trace_name>, <point_index>, <point_value>	Not SCPI Approved

Table C-2. Model 295 SCPI Command Syntax (Continued)

KEYWORD	PARAMETER FORM	NOTES
TRACe<n> (cont'd)		
:DELete	Confirmed	
[:NAME]	<trace_name>	Confirmed
:ALL		Confirmed
:DIRectory?		Not SCPI Approved
:FREE?	<points available>,<points in use>	Confirmed
:LCONTiguous?	<numeric data>	Not SCPI Approved
:LIMits	<trace_name>, <start_index>, <stop_index>	Not SCPI Approved
:MODE	**<CW** | RASTer>	Not SCPI Approved
:POINts	<trace_name>,<numeric_value>	Confirmed
:REName	<trace_name>,<trace_name>	Not SCPI Approved
:SELect	<trace_name>	Not SCPI Approved
TRIGger<n>		Confirmed
:COUNt	<numeric_value>	Confirmed
:GATE		Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
[:IMMediate]		Confirmed
:POLarity	**<POSitive** | NEGative>	Not SCPI Approved
:SOURce		Confirmed[1]
[:STARt]	**<INTernal** | BUS | EXTernal | MASTer | INPut0 | INPut1 | INPut2>	Not SCPI Approved
:ADVance	**<INTernal** | BUS | EXTernal | MASTer | INPut0 | INPut1 | INPut2>	Not SCPI Approved
:TIMer	<numeric_value>	Confirmed
DISPlay		Confirmed
TEXT	<string>	Not SCPI Approved
CLEar		Not SCPI Approved
UPDate		Not SCPI Approved
HVOLtage<n>		Not SCPI Approved
:OUTPut		Not SCPI Approved
[:STATe]	<Boolean>	Not SCPI Approved
:CINPut		Not SCPI Approved
HVOLtage<n> Continued		
[:STATe]	<Boolean>	Not SCPI Approved
:SUM	<Boolean>,<Boolean>,<Boolean>	Not SCPI Approved
[:LEVel]		Not SCPI Approved
[:IMMediate]		Not SCPI Approved
[:AMPLitude]	<numeric_value>	Not SCPI Approved
:RESet		Not SCPI Approved
:VERSion?		Not SCPI Approved
STATus		Confirmed[3]
:OPERation		Confirmed[3]
:CONDition?		Confirmed[3]
:ENABle	<numeric_value>	Confirmed[3]
[:EVENt]?		Confirmed[3]

Table C-2. Model 295 SCPI Command Syntax (Continued)

KEYWORD	PARAMETER FORM	NOTES
STATus (cont'd)		
QUEStionable		Confirmed[3]
:OPERation		Confirmed[3]
:CONDition?		Confirmed[3]
:ENABle	<numeric_value>	Confirmed[3]
[:EVENt]?		Confirmed[3]
:PRESet		Confirmed[3]

1. Device dependent parameter character data.
2. Incomplete implementation; at least one parameter not supported per SCPI specification.
3. STATus Subsystem commands operate per the specification, but the physical Status Registers are not implemented in the hardware.

D.1 INTRODUCTION

The High Voltage Module, Option 007, provides outputs of up to 100 Vp-p into 500Ω. The module consists of three high voltage amplifiers, each of which accepts inputs from installed arb channels and an external summing input. Control of the module is through front panel menu or remote commands. The High Voltage Module must be installed in the slot normally reserved for arb channel 4. For High Voltage Module specifications, refer to Section 2, paragraph 2.2.16 (Options), subparagraph 007 High Voltage Module.

NOTE *The High Voltage Module set-up cannot be stored using the INSTRUMENT / STORED SETUPS screen. You must set up this screen each time you power up.*

This appendix covers:

- Installation of the High Voltage Module in Model 295.
- Operation of the High Voltage Module including connections, screen descriptions, and general operation. Section 5 of the Model 295 Operator's Manual covers remote operation of the High Voltage Module.

D.2 HIGH VOLTAGE BOARD INSTALLATION

The High Voltage Module can be shipped installed in the Model 295 or separately. If shipped separately, the High Voltage Module must be installed in the Model 295 before use. Use the following procedure to install the High Voltage Module in the field:

1. Disconnect the power cord from the Model 295.
2. Remove the cover plate or arb channel board from Channel 4; refer to Figure D-1.
   a. Remove the two screws from the rear panel cover plate of Channel 4, and remove the plate.
   b. Or, remove the two screws securing the Channel 4 arb channel card, and remove the arb Channel card from the instrument.

NOTE *It may be necessary to loosen the screws holding arb Channels 1, 2, and 3 (cover plates too) to ensure the High Voltage Modules is seated in position 4. Be sure to re-tighten the screws.*

3. Slide the High Voltage Module into Channel 4. Secure the module with the two screws.

4. Connect the power cord to the Model 295.

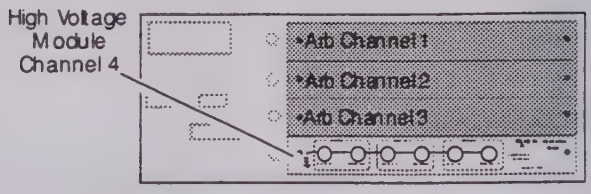


Figure D-1. High Voltage Module Location

After High Voltage Module installation, verify the High Voltage Module is installed by performing the following:

1. Turn on the POWER switch.
2. Press the front panel INSTRUMENT key.
3. Select OPTIONS from the menu.
4. Select HIGH VOLTAGE from the menu.
5. The screen now displays the *High Voltage Option* screen (Figure D-2). An error message is displayed instead if the module is not installed.

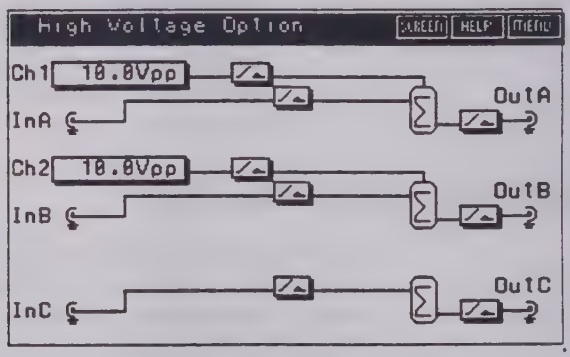


Figure D-2. High Voltage Screen

D.3 OPERATION

This paragraph describes the set-up and operation of the High Voltage Module. Paragraph D.3.1 describes the module's connectors. Paragraph D.3.2 describes the High Voltage Option screen. Finally, paragraph D.3.3 explains operation of the High Voltage Module.

D.3.1 High Voltage Module Connections

The High Voltage Module consists of three high voltage channels each with two sets of connectors: MAIN OUT and EXT SUM IN. Figure D-3 illustrates the High Voltage Module's panel, and table D-1 briefly describes the connectors and their functions.

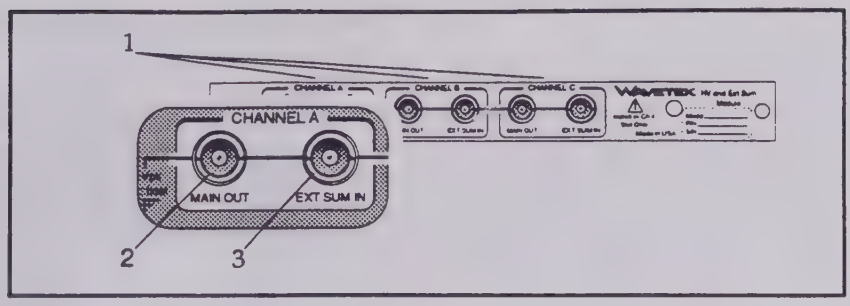


Figure D-3. High Voltage Module

Table D-1. High Voltage Module Connectors

Item	Description
1	**Channels A, B, and C** - Three high voltage channels which contain Main Output and External Summing Input connectors. Each high voltage channel sums up to two High Voltage Inputs with its initial arb channel and an external signal.
2	**Main Out** - High voltage channel output connector. One each for Channels A, B, and C. Source Impedance: 5Ω Output Current: ±80 mA Range: 10 Vp-p to 100 Vp-p (500Ω)
3	**Ex Sum In** - High voltage channel external summing input connector. One each for Channels A, B, and C. Maximum input: 10 Vp-p (±5 Vdc) Gain: 10 Vout/Vin

D.3.2 High Voltage Module Screen

The High Voltage Option screen gives you complete control of the High Voltage Module. You can find this screen only when the High Voltage Module is installed. You can also control the High Voltage Module using the SCPI subsystem: HVOLtage<n>.

D.3.2.1 Getting To The High Voltage Option Screen

1. Verify that the High Voltage Module is installed in position 4 slot before turning on Model 295.
2. Connect the instrument to the primary power source, and press the POWER button to turn on the unit.

3. Press the INSTRUMENT key and select OPTIONS from the pop-up menu. Refer to Figure D-4.

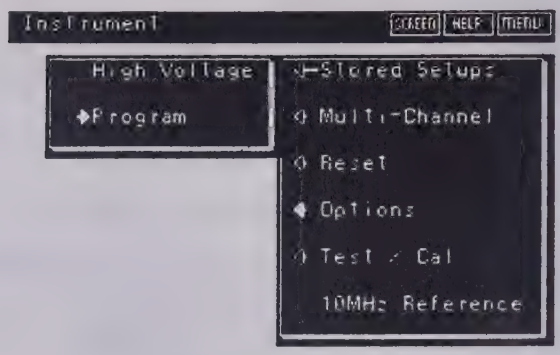


Figure D-4. Instrument/Option Screens

4. Select HIGH VOLTAGE from the OPTION screen. The Model 295 displays the High Voltage Option screen (Figure D-5).

D.3.2.2 High Voltage Option Screen

Use the High Voltage Option screen to route arb channels into the high voltage amplifiers, to enable external summing input signals, to set up arb channel levels, and to connect high voltage amplifiers to their output connectors.

If an arb channel is not installed, the Channel Value field and its associated input switch will not be shown. High Voltage Input channel numbers appear on the screen in the Input Switch Group only when an initial channel is selected. Figure D-5 illustrates a unit with all three arb Channels installed and selected on the screen; call outs in the figure refers to the A amplifier section.

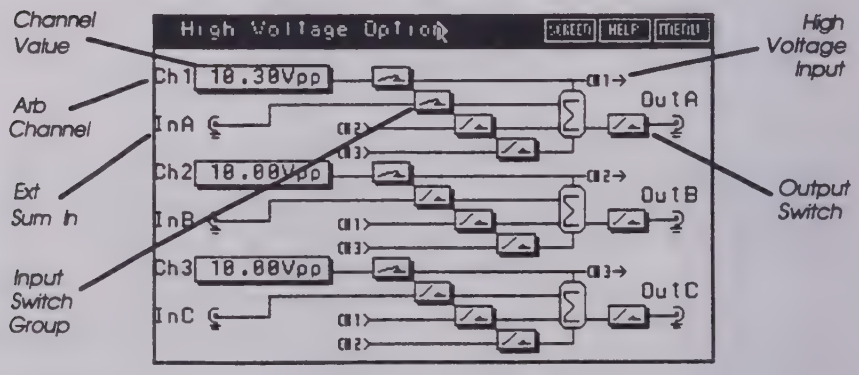


Figure D-5. High Voltage Option Screen

D.3.2.3 Input Switch Group

The Input Switch Group connects summing inputs to the high voltage amplifier. This screen can display three Input Switch Groups - one set for each high voltage amplifier. One switch in the group connects the arb channel (Ch1, Ch2, and Ch3) to the High Voltage Input. Another switch in the group connects the External Summing Input (In A, In B, In C) to the summing input. Other switches in the group connect other High Voltage Input channels (CH1, CH2, or CH3) to the high voltage amplifier.

Arb Channel Switch

This switch routes the scaled arb channel (displayed as Ch 1, Ch 2, and Ch 3) directly to its high voltage amplifier and to other High Voltage Inputs. The High Voltage Input numbers (displayed as CH 1, CH 2, and CH 3) also appear next to the switches.

Arb Channel 1 (Ch 1) connects to High Voltage Input - Amplifier A (Out A).

Arb Channel 2 (Ch 2) connects to High Voltage Input - Amplifier B (Out B).

Arb Channel 3 (Ch 3) connects to High Voltage Input - Amplifier C (Out C).

Use the Channel Value to adjust the level driving the High Voltage Input.

Ex Sum In Switch

This switch connects the External Summing Input, displayed as InA, InB, and InC, to the summing input of the high voltage amplifier. Maximum input level to the connector is 5 Vpk, and bandwidth is >1 MHz. The input signal is scaled by -10 Vout/Vin.

High Voltage Inputs

Switches displayed as CH1, CH2, and CH3 connect High Voltage inputs to the high voltage amplifier. The level for these inputs is fixed at the value set by the Channel value. High Voltage Input numbers appear only after an arb channel is selected.

D.3.2.4 Channel Value

Selecting this field sets the arb channel's voltage level. Use either the front panel keypad or mouse to change the value. Programmable range is 10 Vp-p to 100 Vp-p (three digits of resolution) into 500Ω. At power on, Model 295 sets the value to 10 Vp-p. The Channel Values set from this screen are independent of the levels set from the *Channel Setup* screen. When this level is set, it defines the level as all High Voltage Inputs. Thus, setting the level to 50 Vp-p sets the level to 50 Vp-p for all enabled High Voltage Inputs.

NOTE *Remember, the High Voltage set-up cannot be stored.*

The Model 295 allows you to sum levels that would normally exceed 100 Vp-p. This allows for waveform phasing or *arbitrary waveform*. Model 295 displays a warning message when two or more summed input levels exceed a combined amplitude value of 100 Vp-p. But Model 295 retains the programmed values.

CAUTION *If the sum of the voltage level for two or more High Voltage Inputs exceeds 100 Vp-p, Model 295 displays a warning message, but it accepts these levels because the actual sum depends on the signal phase. If the actual combined signal exceeds 100 Vp-p the output signal is clipped if the peak level occurs at the same phase.*

D.3.2.5 Output Switch

These switches connect high voltage amplifiers to their respective output connectors. Each time a switch is selected, the switch toggles between open and closed. Always wait to close an output switch after the high voltage channel is set up to minimize damage or shock hazard. Model 295 disconnects all output switches at power up.

WARNING **Outputs from Out A, B, and C produce voltage levels as high as 100 Vp-p. Contacting these connectors or the wires from these connectors could cause serious injuries.**

D.3.3 High Voltage Module Operation

This paragraph illustrates how to combine the High Voltage Module with its menu screen to supply a high voltage output signal.

D.3.3.1 Output Considerations

Each High Voltage amplifier provides a low impedance source (5Ω) which can drive a load of up to 80 mA. The Channel Value, as well as the specifications in appendix A, are specified into a 500Ω termination. The main limiting factor, regardless of termination impedance, is the maximum Main Out's levels: 80 mA (max) or 50 Vpk (max). Thus actual load impedances can vary depending on the output level and the output current. The graph, figure D-6, shows the output termination versus output level at a maximum output current of 80 mA. Interconnecting cable should have >10 MHz bandwidth. Cables with poor performance can be used with decreased bandwidth.

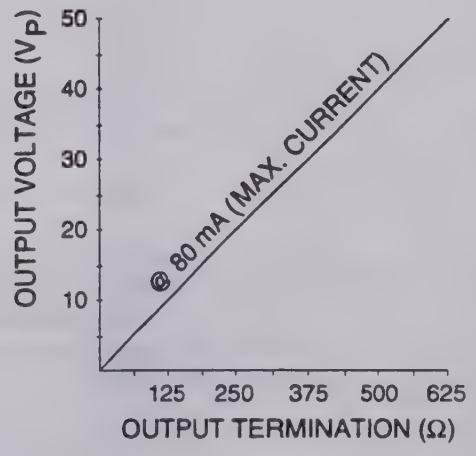


Figure D-6. Output Termination Versus Output Level

Total current output (all three outputs) of the High Voltage Option is limited to 210 mA [$|I_{CHA}| + |I_{CHB}| + |I_{CHC}| \leq 210$ mA]. For best operation do not exceed this limit.

D.3.3.2 Operation

The next procedures provide a checklist for High Voltage Module set-up and operation.

First, basic operation: initial arb channel output.
Second, External Summing Input.
Finally, multiple channel operation.

It is assumed that the High Voltage Module is installed in Model 295 and functioning correctly.

Initial Arb Channel Output

1. Connect Model 295 to its primary power source, and press the POWER button to turn the unit on.
2. Press the INSTRUMENT key, and select OPTION from the menu.
3. Select HIGH VOLTAGE from the menu.
4. Select the desired arb channel switch (for either Ch 1, Ch 2, or Ch3) and click on it to route that signal to the High Voltage Input.
5. Using the mouse, click on the Channel Value box for the selected channel and then set the value using the keypad or use the default value for verification.
6. Using the proper cables and terminations, connect the selected High Voltage Main Out to the external measuring circuit.
7. Click on the associated Output Switch (as selected in step 4) to connect the Summing Amplifier to the High Voltage Main Out connector.
8. Verify that the appropriate signal is present at the High Voltage Main Output connector.

External Sum Input

1. Perform steps 1 through 3 in *Initial Arb Channel Output*.
2. Select the "In A" (or "In B", or "In C") External Summing Input switch to connect that external input connector to the High Voltage input.
3. Using the proper cables and terminations, connect the External Summing Input connector to an external signal source.

NOTE *Remember, the High Voltage Amplifier provides a gain of -10. For example, a 2 Vp-p signal at the input connector produces a 20 Vp-p, 180° phase shifted output at the Main Out connector. Also, a -2 Vdc at the input connector produces a +20 Vdc output at the Main Out connector.*

NOTE *If the external source has 50Ω source impedance, an external 50Ω load must be placed at the Ext Sum In connector.*

4. Perform steps 6, 7, and 8 in *Initial arb Channel Output*.

Multiple Channel Outputs

1. Perform steps 1 through 3 in *Initial Arb Channel Output*.
2. Select the desired arb channel switch (for either Ch 1, Ch 2, or Ch3) and click on it to route that signal to the High Voltage Input.
3. Using the mouse, click on the Channel Value box for the selected channel and then set the value using the keypad or use the default value for verification.
4. Select the High Voltage Input switch to select an input from another arb Channel.

NOTE *Remember, the Channel Value is fixed by the primary high voltage channel.*

5. Select the "In A" (or "In B", or "In C") External Summing Input switch to connect that connector to the High Voltage input.
6. Connect the External Summing Input connector to an external signal source.

NOTE *Remember, the High Voltage Amplifier provides a gain of -10. For example, a 2 Vp-p signal at the input connector produces a 20 Vp-p, 180° phase shifted output at the Main Out connector. Also, a -2 Vdc at the input connector produces a +20 Vdc output at the Main Out connector.*

7. Perform steps 6, 7, and 8 in *Initial Arb Channel Output*.

D.3.4 Remote

This appendix does not cover remote operation of the High Voltage board. Refer to Model 295 Operator's Manual, Section 5, HVOLTAGE<N>, for more information. For a description of the SCPI commands for the High Voltage board, refer to Figure C-15 in Appendix C of this manual.

E.1 KIT INSTALLATION INSTRUCTIONS

Refer to Figure E-1 on the following page while following the step-by-step instructions. Table E-1 lists the parts supplied with the rack mounting kit. Reference designators in table E-1 are keyed to the index numbers in figure E-1.

1. Remove cover screws, 2 places per cover. Slide covers back and off the unit.
2. Remove side panel screws, 2 places per side panel. Slide side panels back and off the unit.
3. Remove foot mounting hardware and feet, 4 places.
4. Re-install covers using original hardware. Do not re-install side panels.
5. Install rack ear/handle (item number 5) and adapter (item number 6) 2 places, using hardware item number 4, 3 places per side.
6. Install rack slide (item number 2 – only inner member is illustrated for clarity) and adapter (item number 1) 2 places, using hardware item number 3, 3 places per side. Note orientation of item number 1. Surface with slots must be up against side of chassis.

Table E-1. Rack Mount Parts List

Ref	Description	Org Mfgr #	Mfgr	Wtk #	Qty
1	Bar, Adapter, Rack slide	1400-02-5251	Wvtk	1400-02-5251	2
2	Slide, 20 in. made from 2400-06-0002	2400-99-0002	Wvtk	2400-99-0002	2
3	Screw, 10-32X1,TRS	10-32 X 1 TRS	CMRCL	2800-20-0116	8
4	Screw, 82°. F-Head Phillip, 6-32, 3/4 LG Stainless Steel	6C75FXS	WFAST	2800-54-0216	8
5	Handle/Rack Ear	1400-02-5250	Wvtk	1400-02-5250	2
6	Adapter, Handle/ Rack Ears	1400-02-5252	Wvtk	1400-02-5252	2
7	Bracket	JPN-SP0440	NL	2400-07-0003	4
8	Nut, Hex, 8-32, Z	8-32 Hex Nut	CMRCL	2800-14-8100	10
9	Washer, Flat, #8	#8 FW	CMRCL	2800-26-8000	10
10	Screw, Pan, CAD I, Cross Recess, 8-32 X 3/8	8-32 X 3/8 Pan	CMRCL	2800-38-8106	10
11	Lockwasher, #8 Split Ring, SS	#8SRLW	CMRCL	2800-42-8000	10

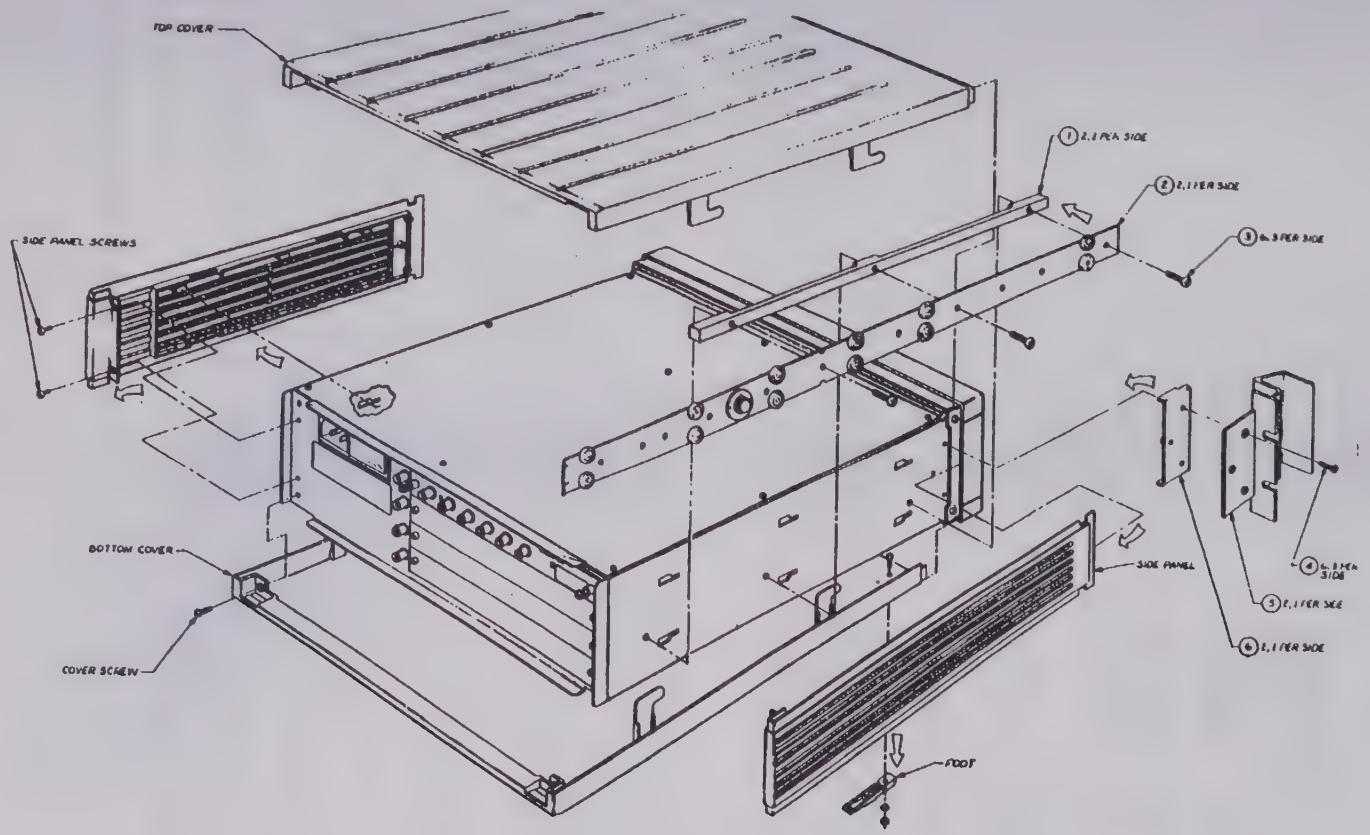


Figure E-1. Model 285 Rackside Kit

Refer to the previous page for the step-by-step instructions. Also, the previous page contains a list of items (table E-1) included in the rack mount kit. Numbered items referenced in figure E-1 are listed as reference designators in table E-1.

F.1 INTRODUCTION

Refer to the listing on the following page for the recommended spare parts for the model 295. These parts can be ordered as a kit or individually

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ENCODER KNOB ASSY REF: A/D 1201-00-3380	1200-00-3380	WVTK	1200-00-3380	1
NONE	SL ZR 6.2V 5% 400MW (1N753A)	1N753A	ROHM	131.9620	1
NONE	CONN, BNC(PC)	227161-1	AMP	2100-01-0019	2
NONE	FUSE,3/4A,250V,S-B	313-750	LITFU	2400-05-0011	5
NONE	FUSE,1 1/2A,250V,S-B	MDX 1-1/2	BUSS	2400-05-0021	5
NONE	RELAY,2 FORMC,5V,DIP 14	DF2E-DC5V	AROMT	4500-00-0033	1
NONE	RELAY,1 FORMC,5V,.312H,.296W	HD1E-M-DC5V	AROMT	4500-00-0034	1
NONE	DIODE, ZENER, 3.3V, 5% TOL,500MW,G/B,IN746A	1N746A	FAIR	4801-01-0746	1
NONE	DIODE, ZENOR, 5.1V, 500MW, GIB, IN751A	1N751A	FAIR	4801-01-0751	1
NONE	DIODE, HIGH CONDUCTANCE, ULTRA FAST	1N5282	FAIR	4801-01-5282	2
3	DIODE,1N4002 GEN PURPOSE RECT. 100V,1A	1N4002	FAIR	4801-02-0001	1
NONE	DIODE, ULTRA FAST	1N4244	T/CSF	4807-02-0777	1
NONE	TRANS 2N2219A NPN GENERAL PURPOSE TO-5	2N2219A	NSC	4901-02-2191	2
NONE	TRANS 2N2905A PNP GENERAL PURPOSE TO-5	2N2905A	NSC	4901-02-9051	2
NONE	TRANS, NPN, TO-92	PN3563	NSC	4901-03-5630	2
NONE	TRANS	2N3866	MOT	4901-03-8660	2
NONE	TRANS	2N5160-18(OBS)	MOT	4901-05-1600	2
NONE	TRANS 2N5583 PNP HIGH FREQ TO-39	2N5583	MOT	4901-05-5830	2
NONE	TRANS 2N5771 PNP SWITCH TO-92	2N5771	NSC	4901-05-7710	2

WAVETEK PARTS LIST	TITLE MODEL 295 ARB SPARE PARTS KIT PARTS LIST	ASSEMBLY NO. 1200-00-3480 PAGE 1	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	TRANS,NPN,HIGH FREQ	2N5943	MOT	4901-05-9430	1
NONE	TRANS,FET N CHANNEL	VN0106N3	SUPER	4902-01-0600	2
NONE	TRANS,FET P CHANNEL	VP0106N3	SUPER	4902-01-0601	2
NONE	TRANSISTOR,PNP,HI FREQ,MED PWR SELECTED	SRF2573	MOT	4902-02-5730	1
NONE	TRANSISTOR,NPN,HI FREQ, MED PWR SELECTED	4902-02-5740	WVTK	4902-02-5740	1
NONE	VOLT REGULATOR, 3 TERMINAL ADJUSTABLE POS	LM317T	NSC	7000-03-1700	1
NONE	REG,NEG,ADJ,3 TERM,1%	LT337AT	LTECH	7000-03-3702	1
NONE	COMPARATOR, DUAL DIFFERENTIAL, SENSE AMP	NE521N	SIG	7000-05-2100	1
NONE	REGULATOR,POS. ADJ,LOW DROPOUT	LT1086CT	LINTE	7000-10-8600	1
NONE	DAC,OCTAL,8-BIT,SERIAL	MB88342-P	FUJI	7000-88-3420	1
NONE	OP AMP,HI SLEW RTE,WIDEBND,JFET,STD	MC34081P	MOT	7003-40-8100	2
NONE	OP AMP,HI SLEW RTE,WIDEBND,JFET DUAL	MC34082P	MOT	7003-40-8200	2
NONE	OP AMP,HI SLEW RTE,WIDEBND JFET	MC34084P	MOT	7003-40-8400	1
NONE	MECL 10KH HIGH-SPEED ECL	MC10H102P	MOT	8001-01-0201	1
NONE	PIN DRIVER,HIGH SPEED	HL108020	HITEC	8010-80-2200	1
NONE	PRESCALER,DUAL MODULUS,DIVIDE-BY-64/65,ECL	MC12017P	MOT	8012-01-1700	1
NONE	GATE ARRAY, 84 PIN, CLA54036	8700-00-0003	WVTK	8700-00-0003	1

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